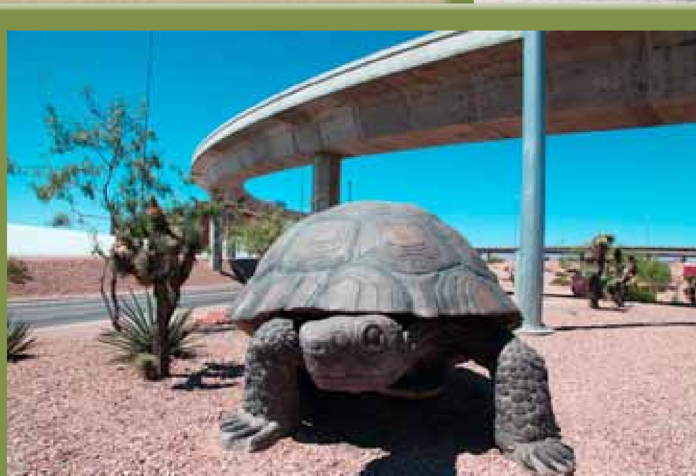
STATE HIGHWAY PRESERVATION REPORT

NEVADA DEPARTMENT OF TRANSPORTATION



February 2011

State of Nevada

Department of Transportation

State Highway Preservation Report

Report to the 2011 Legislature
As Required by Nevada Revised Statute 408.203 (3)

February 2011

Nevada Revised Statute 408.203(3)

The director of the Nevada Department of Transportation shall report to the Legislature by February 1 of odd-numbered years the progress being made in the Department's 12-year plan for the resurfacing of state highways. The report must include an accounting of revenues and expenditures in the preceding two fiscal years, a list of the projects which have been completed, including mileage and cost, and an estimate of the adequacy of projected revenues for timely completion of the plan.

State of Nevada

Department of Transportation

Mission

The Department provides a better transportation system for Nevada through unified and dedicated efforts.

Vision

The Department is the nation's leader in delivering transportation solutions, improving Nevada's quality of life.

Values

The efforts of Department employees to attain the Department goals will be governed by the following Department's Core Values:

Integrity – Doing the right thing
Honesty – Being truthful in our actions and our words
Respect – Treating others with dignity
Commitment – Putting the needs of the Department first
Accountability – Being responsible for our actions

Goals

The fulfillment of the Mission of the Department is to be attained within the guidelines of the Department's seven Strategic Plan Goals. They are:

To optimize safety
To be in touch with and responsive to our customers
To innovate
To be the employer of choice
To deliver timely and beneficial projects and programs
To effectively preserve and manage our assets
To efficiently operate the transportation system

Table of Contents

List of Tables

List of Figures

EXECUTIVE SUMMARY

To preserve the existing highway system, the State of Nevada will need to increase the highway preservation funding by $181 million annually for next 12 years.

If no action is taken to address the funding needs:

- **The highways and bridges will deteriorate at a rate of $244 million annually.**
- **The user costs to Nevadans, in terms of vehicle maintenance and fuel costs will be $362 million annually.**

INTRODUCTION

The Nevada Department of Transportation (NDOT) publishes the *State Highway Preservation Report* biennially to summarize the recently performed work and anticipated workload required to preserve the state-maintained roadway network and bridge infrastructure assets. This report provides the Nevada Legislature with information that can be used to determine whether future revenues are adequate to maintain and preserve the infrastructure assets at acceptable levels of service. NDOT is responsible 5,312 miles of state-maintained roadway network worth approximately $20 billion and 1,097 bridges worth approximately $2 billion. Although the state-maintained roadway network consists of only 16% of the roads in Nevada, the network is overwhelmingly important as 56% of all automobile traffic and 87% of all heavy truck traffic travel on these roads.

PAVEMENT MANAGEMENT

The primary objective of pavement management is to improve the condition of the entire roadway network while maximizing pavement performance and keeping costs to a minimum. NDOT accomplishes this objective with use of a pavement management system (PMS). The PMS supports the pavement management process by providing an inventory and condition of existing pavement assets as well as recommended repairs and repair costs. The known repair costs are used to forecast short and long-term funding requirements.

Of the 5,312 miles of state-maintained roadway network surveyed in 2009, 1,331 miles or 25.1% of the pavement require preventive maintenance treatments; 2,456 miles or 46.2% of the pavement need corrective maintenance treatments; 606 miles or 11.4% of the pavement require an overlay repair strategy; and 919 miles or 17.3% of the pavement need a reconstruction repair strategy. The pavement in need of corrective maintenance treatments will eventually deteriorate into conditions that require overlay or reconstruction.

FIGURE 1 presents the current pavement condition of the state-maintained roadway network. The figure illustrates the total number of miles required to improve the roadways to acceptable levels of service for each repair category based on the functional classification inventory. Compared to the pavement condition in the last biennium, an additional 9.4% of the pavement has deteriorated from the need for maintenance treatments to the need for overlay and reconstruction work mainly due to the age of the network. Last biennium, 19.3% of the pavement required an overlay or reconstruction as compared to 28.7% of the pavement that require an overlay or reconstruction today.

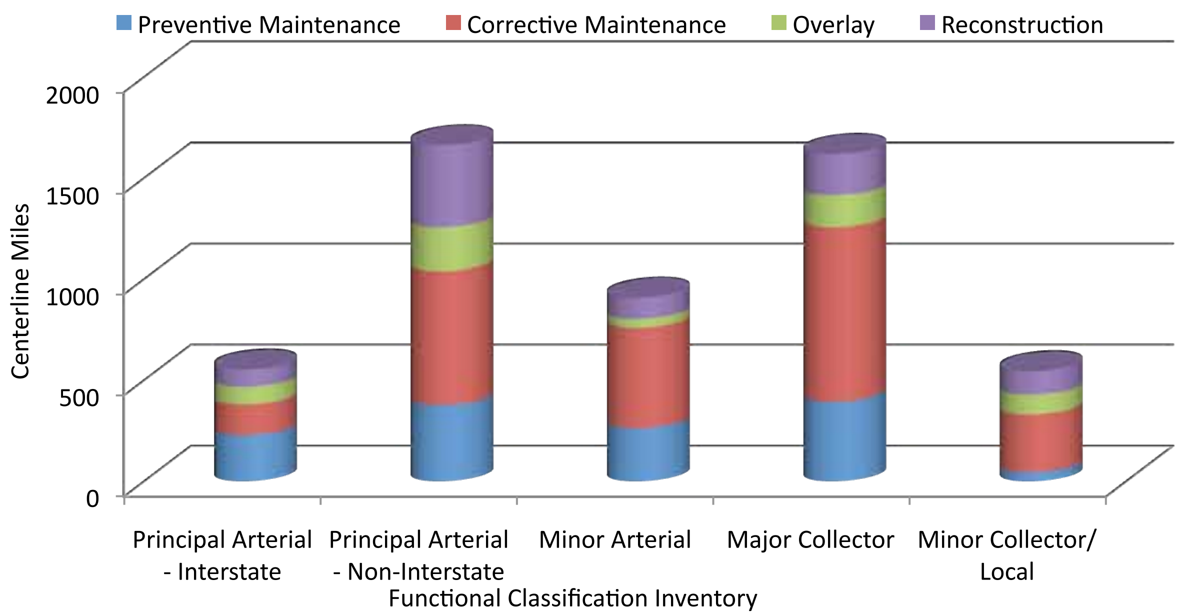


FIGURE 1: Pavement Condition on the State-maintained System by Functional Class inventory and Required Repair Strategy

BRIDGE MANAGEMENT

Bridges are managed via the PONTIS Bridge Management System. This system provides an inventory of bridges. These inventories, together with other factors, allow NDOT to identify preservation priorities and monitor the state's progress toward eliminating the backlog of bridge work.

NDOT inspects all the bridges in Nevada regardless of ownership whether by federal, state, county, city or private entities. Of the 1,924 bridges surveyed in 2010, 1,526 bridges or 82% are considered to be in good condition; 263 bridges or 14% are considered to be in fair condition; and 18 bridges or 1% are considered to be in poor condition. 56 bridges or 3% of the bridges were inspected for safety but not rated. FIGURE 2 presents the current bridge condition of the state-surveyed bridge network for both state-maintained and locally-maintained bridges. Compared to the bridge condition in the last biennium 'Good' condition bridges have increased by 4%; 'Fair' condition bridges have decreased by 1%; and poor condition bridges have decreased by 0.5%.

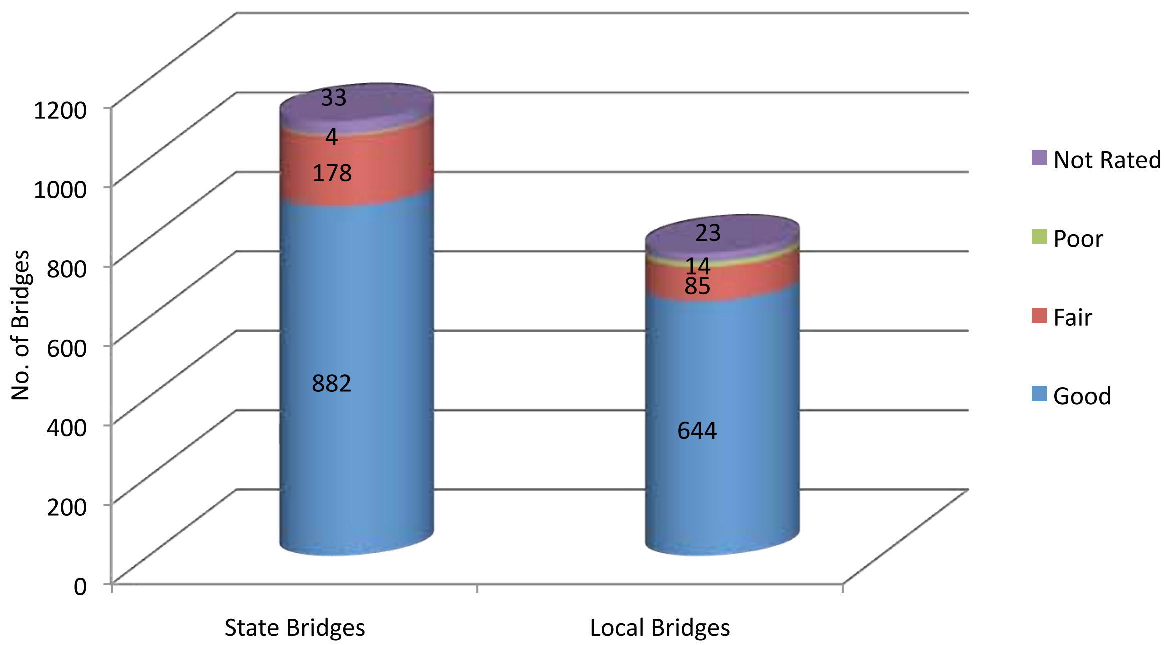


FIGURE 2: Condition of Nevada's Bridges

The majority of the state-maintained bridges were built in the 1960s through the 1980s. Since Nevada's bridges have a typical service life of 50 years, it can be estimated when the bridges will become due for major rehabilitation or replacement. FIGURE 3 illustrates that many bridges became due for major rehabilitation or replacement beginning in 2010.

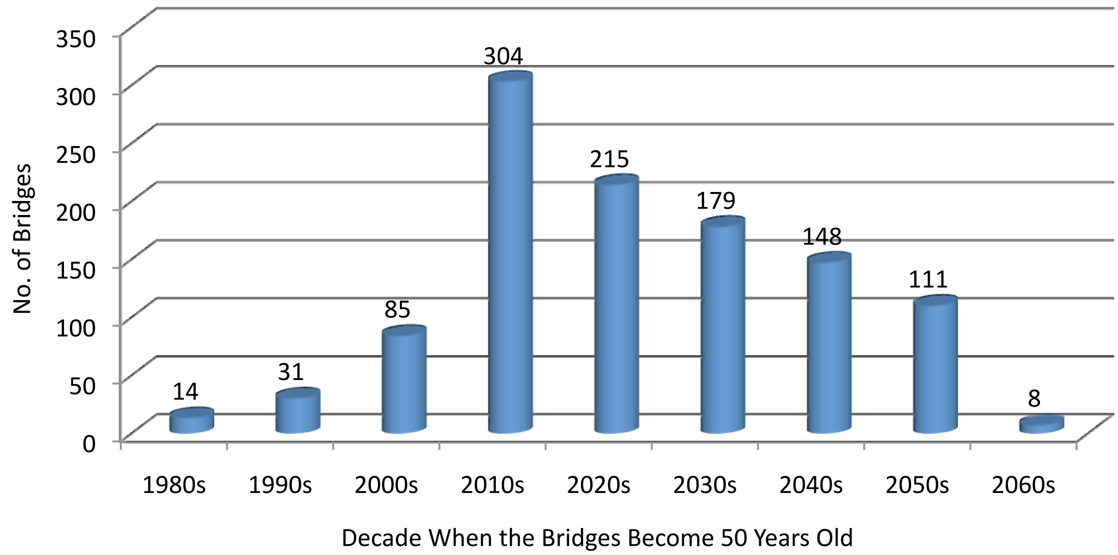


FIGURE 3: Number of 50 Year Old Bridges by Decade

PAVEMENT AND BRIDGE PRESERVATION WORK BACKLOG

TABLE 1 shows the estimated $1.36 billion backlog of pavement and bridge preservation work in fiscal year 2011. This backlog includes $1.23 billion for pavement work and $130 million for bridge work.

TABLE 1: Backlog of Pavement and Bridge Work - 2011
(State-Maintained System – Based on 2009 Condition Data)

System	Pavement	Bridges	Total
Principal Arterial - Interstate	$221,878,216	$27,430,000	$249,308,216
Principal Arterial - Non-Interstate	$490,524,499	$15,190,000	$505,714,499
Minor Arterial	$130,671,007	$6,760,000	$137,431,007
Major Collector	$240,418,547	$7,920,000	$248,338,547
Minor Collector & Local	$141,953,311	$9,620,000	$151,573,311
Seismic Retrofit (System Not Identified)		$64,000,000	$64,000,000
Total	**$1,225,445,581**	**$130,920,000**	**$1,356,365,581**

During the last two years, the backlog increased by $638 million from $718 million documented in the last biennium. The increasing backlog is primarily due to highway-construction inflation not being matched by revenue increases from fuel taxes and vehicle registration fees over the years. Moreover, preservation work competes with congestion relief, safety, and other enhancement projects.

If the present funding level continues, the backlog is expected to increase to a total of $2.2 billion in 2023. If the funding is increased by $181 million per year (On average over the next 12 years), the backlog can be eliminated by 2023. FIGURE 4 illustrates the comparison between the increase in the total backlog for pavement and bridge preservation that will occur during the next 12 years if the present funding level remains the same and the decrease in backlog if the funding level was increased.

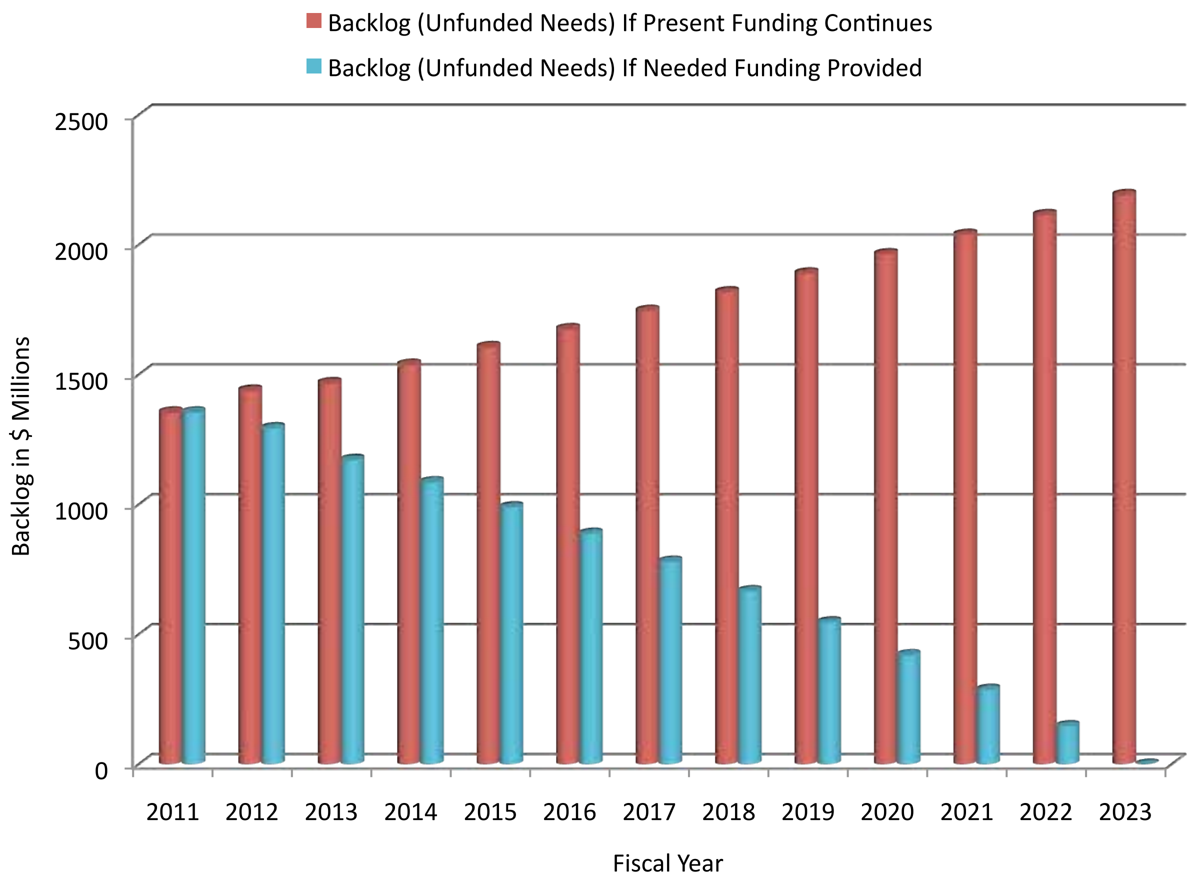


FIGURE 4: Backlog of Pavement and Bridge Preservation Work with Present Funding Level versus Needed Funding Level

TABLE 2 lists detailed backlog in numerical format for fiscal years 2011 through 2023.

TABLE 2 - Pavement and Bridge Backlog, Costs, and Funding

State-Maintained System - 2011 - 2023 (in millions of dollars)

With Present Funding

Fiscal Year	Backlog of Pavement and Bridge Work	Pavement Preservation Costs * (Normal Annual Deterioration Costs): Pavement Total	Bridge Total	Pavement and Bridge Total	Pavement Preservation Funds ** (Funds Planned for Preservation Work): State Funding	Federal Funding	State Maintenance		Total
2011	**1356.4**	204.4	12.8	217.2	57.1	52.5	23.3		132.9
2012	**1440.7**	180.0	13.6	193.6	64.3	76.6	24.0		164.9
2013	**1469.4**	206.5	14.4	220.9	56.6	68.8	24.7		150.1
2014	**1540.2**	209.0	15.3	224.3	60.8	70.1	25.4		156.3
2015	**1608.2**	215.3	16.2	231.4	63.2	72.9	26.2		162.3
2016	**1677.3**	221.7	17.1	238.8	65.7	75.8	27.0		168.5
2017	**1747.6**	228.4	18.1	246.4	68.4	78.8	27.8		175.0
2018	**1819.1**	235.2	19.1	254.3	71.1	82.0	28.6		181.7
2019	**1891.7**	242.3	20.2	262.5	74.0	85.2	29.5		188.7
2020	**1965.5**	249.5	21.3	270.9	76.9	88.6	30.4		195.9
2021	**2040.4**	257.0	22.5	279.5	80.0	92.2	31.3		203.5
2022	**2116.5**	264.7	23.7	288.5	83.2	95.9	32.2		211.3
2023	**2193.7**								

With Needed Additional Funding

Fiscal Year	Backlog of Pavement and Bridge Work	Pavement Preservation Costs * (Normal Annual Deterioration Costs): Pavement Total	Bridge Total	Pavement and Bridge Total	Pavement Preservation Funds ** (Funds Planned & Needed for Preservation Work): Existing: State Funding	Existing: Federal Funding	Existing: State Maintenance	Needed Additional Funds	Total
2011	**1,356.4**	204.4	12.8	217.2	57.1	52.5	23.3	**144.9**	277.9
2012	**1,295.7**	180.0	13.6	193.6	64.3	76.6	24.0	**150.7**	315.6
2013	**1,173.7**	206.5	14.4	220.9	56.6	68.8	24.7	**156.8**	306.9
2014	**1,087.8**	209.0	15.3	224.3	60.8	70.1	25.4	**163.0**	319.3
2015	**991.2**	215.3	16.2	231.4	63.2	72.9	26.2	**169.6**	331.8
2016	**889.2**	221.7	17.1	238.8	65.7	75.8	27.0	**176.3**	344.9
2017	**781.6**	228.4	18.1	246.4	68.4	78.8	27.8	**183.4**	358.4
2018	**668.0**	235.2	19.1	254.3	71.1	82.0	28.6	**190.7**	372.4
2019	**548.1**	242.3	20.2	262.5	74.0	85.2	29.5	**198.4**	387.1
2020	**421.7**	249.5	21.3	270.9	76.9	88.6	30.4	**206.3**	402.2
2021	**288.5**	257.0	22.5	279.5	80.0	92.2	31.3	**214.5**	418.0
2022	**148.0**	264.7	23.7	288.5	83.2	95.9	32.2	**223.1**	434.4
2023	**0.0**								

* Inflation assumed at 3% per annum.

** Revenue growth rate assumed is 4% per annum.

Note: Backlog of pavement and bridge work is as of beginning of fiscal year; preservation costs are those incurred during the fiscal year; and preservation funds are those that are available during the fiscal year.

SUMMARY

Highway construction costs depend on energy prices and the recent spikes in energy prices have significantly increased pavement preservation costs. The last time Nevada increased its gasoline tax was in 1992. Due to construction inflation, the State Highway Fund gasoline tax of 17.65 cents per gallon in 1992 has the highway construction purchasing power of only 6.87 cents today. The price trend for construction costs rose 260% from 1992 through 2010. Additionally, Nevada's population has more than doubled in the last two decades and congestion in urban areas has increased significantly. Therefore, the backlog continues to rise as the present investment in pavement and bridge preservation has not commensurately increased with inflation and price trends. A recently published TRIP, a Washington DC based transportation advocacy group, report shows that Nevada's deteriorated pavement cost users $362 million a year.

A safe, efficient, and reliable roadway network is a matter of important interest and general welfare to all the people of the State of Nevada. Adequate preservation funding is necessary because deteriorated roads can impede the general economic and social progress of the State. The Nevada Legislature has an opportunity to reinvigorate the investment policy for the State's infrastructure by ensuring that adequate funds are available to properly preserve the pavement and bridge infrastructure. Investment in infrastructure is one means to boost market economy, advance travel and trade, and provide a legacy from which future generations can prosper.

Federal Highway administration estimates that each dollar spent on road and bridge improvement results in an average benefit of $5.20 in the form of reduced vehicle maintenance costs, reduced delays, reduced fuel consumption, improved safety, reduced road and bridge maintenance costs and reduced emissions as a result of improved traffic flow.

A 2007 analysis of federal Highway administration found that every $1 billion invested in highway construction would support approximately 27800 jobs, including approximately 9,500 in the construction sector, 4,300 jobs in industries supporting the construction sector and 14,000 other jobs induced in non-construction related sectors of the economy.

INTRODUCTION

This report summarizes the Nevada Department of Transportation's (NDOT) efforts to preserve the 5,312 centerline miles of state-maintained roadway network. This network consists of only 16% of the roads in Nevada. However, the network is overwhelmingly important as 56% of all traffic and 87% of all heavy trucks travel on these roads. Preserving the roadway network is one of NDOT's highest priorities. Numerous resources are employed to improve pavement condition by using cost-effective maintenance and rehabilitation strategies that maximize pavement performance.

Nevada Legislature's Role in Pavement Preservation Efforts

The Nevada Legislature recognizes that a safe and efficient roadway network is a matter of important interest and general welfare to all the people of the State of Nevada. Adequate pavement preservation funding is necessary because deteriorated roads can impede the general economic and social progress of the State. The State relies on the Legislature to authorize funding sources that can be used to preserve the state-maintained roadway network. The Legislature's involvement in determining whether future revenues are adequate is essential in the success of preservation efforts since approximately 38% of the roadway preservation funds were derived from state-levied taxes in 2009 and 2010. If the onetime ARRA funds are excluded from the total federal funds, the state slice will increase to 58%)

NDOT's Role in Pavement Preservation Efforts

NDOT is responsible to plan, design, construct, maintain, monitor, and protect the $20 billion worth of pavement in Nevada. This is the estimated cost to replace the existing pavement network that includes asphalt/concrete surface, base and sub-base. The pavement assets are managed using a pavement management system (PMS). The PMS supports the pavement management process by providing an objective and systematic methodology for establishing cost-effective maintenance and rehabilitation priorities and scheduling. The PMS provides an inventory of existing pavement assets and condition as well as needed repairs and repair costs. Known repair costs are used to forecast short and long-term funding requirements.

THE PAVEMENT MANAGEMENT SYSTEM

(How do we care for the State pavements?)

The primary objective of pavement management is to improve the condition of the entire roadway network while maximizing pavement performance and keeping costs to a minimum level. The PMS is a tool that assists the engineers with this objective. This tool provides an objective and systematic method for collecting, storing, and evaluating relevant pavement condition data. The performance of preservation strategies and the associated life-cycle costs can be easily forecasted. The PMS improves the efficiency of decision making, provides assessment on the consequences of decisions through comparative analysis, and ensures consistency of network and project level activities and decisions.

Network Inventory

(What do we maintain?)

The state-maintained roadway network contains roads that are functionally classified based on federal standards. Functional classification is a process whereby roads are grouped into classes according to the character of the traffic such as local or long distance mobility and the degree of land access. State-maintained roadways are grouped into the following functional class inventory: Principal Arterial-Interstate, Principal Arterial-Non-interstate, Minor Arterial, Major Collector, and Minor Collector. FIGURE 5 presents the state-maintained roadway network inventory that is identified based on functional class.

The functional class inventory was separated into pavement groups according to the age of pavement to determine the amount of miles that are within or beyond the expected pavement service life for each type of functional class. FIGURE 6 displays the age distribution for each roadway segment based on functional class for the year 2009. FIGURE 7 presents the age distribution for the year 2008 for comparison purposes. A comparison of FIGURE 6 and FIGURE 7 reveals that the number of miles in all classes of roads that are 20 to 30 years and more than 30 years old have increased significantly.

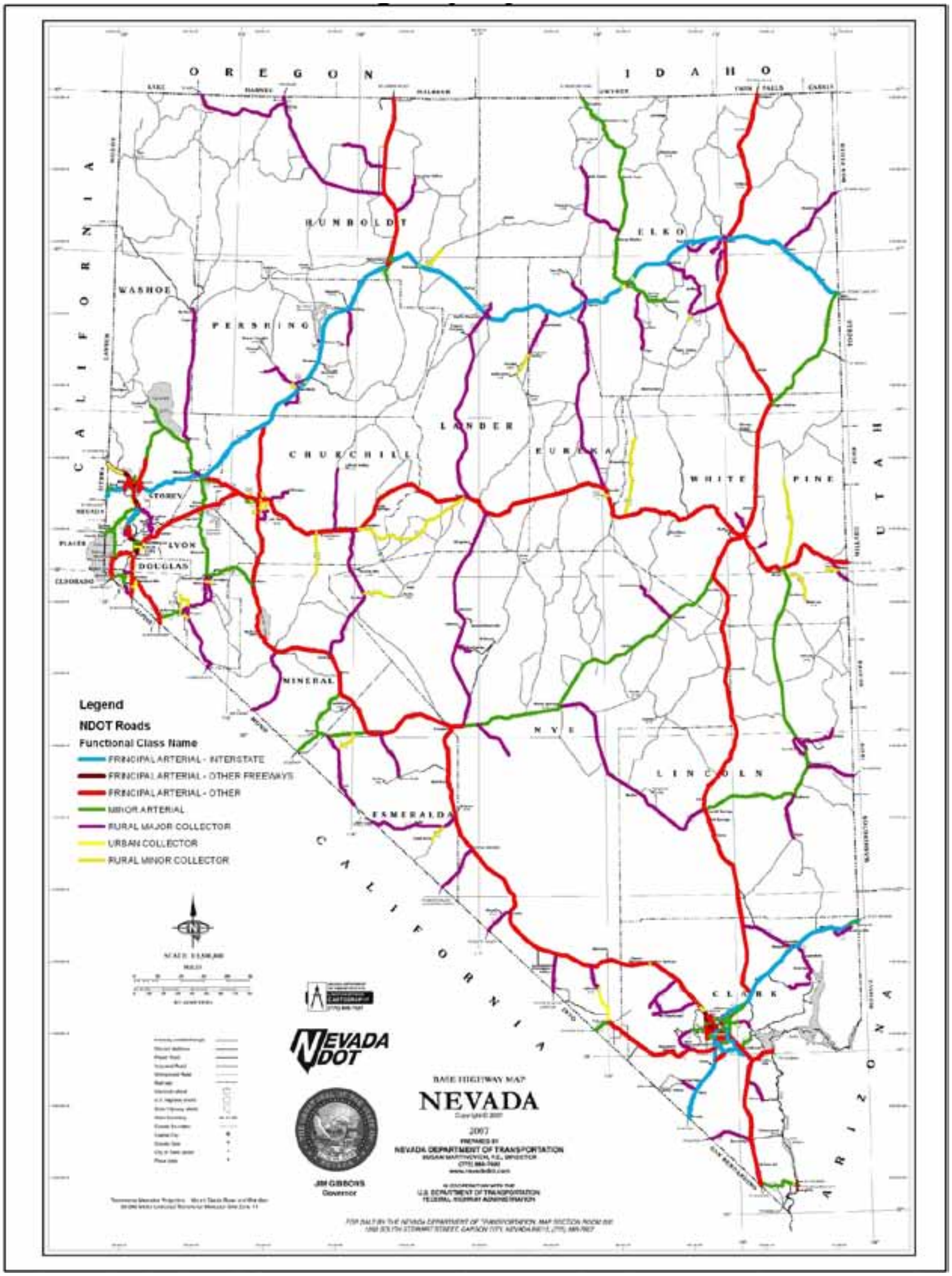


FIGURE 5: Network Inventory Identified by Functional Class

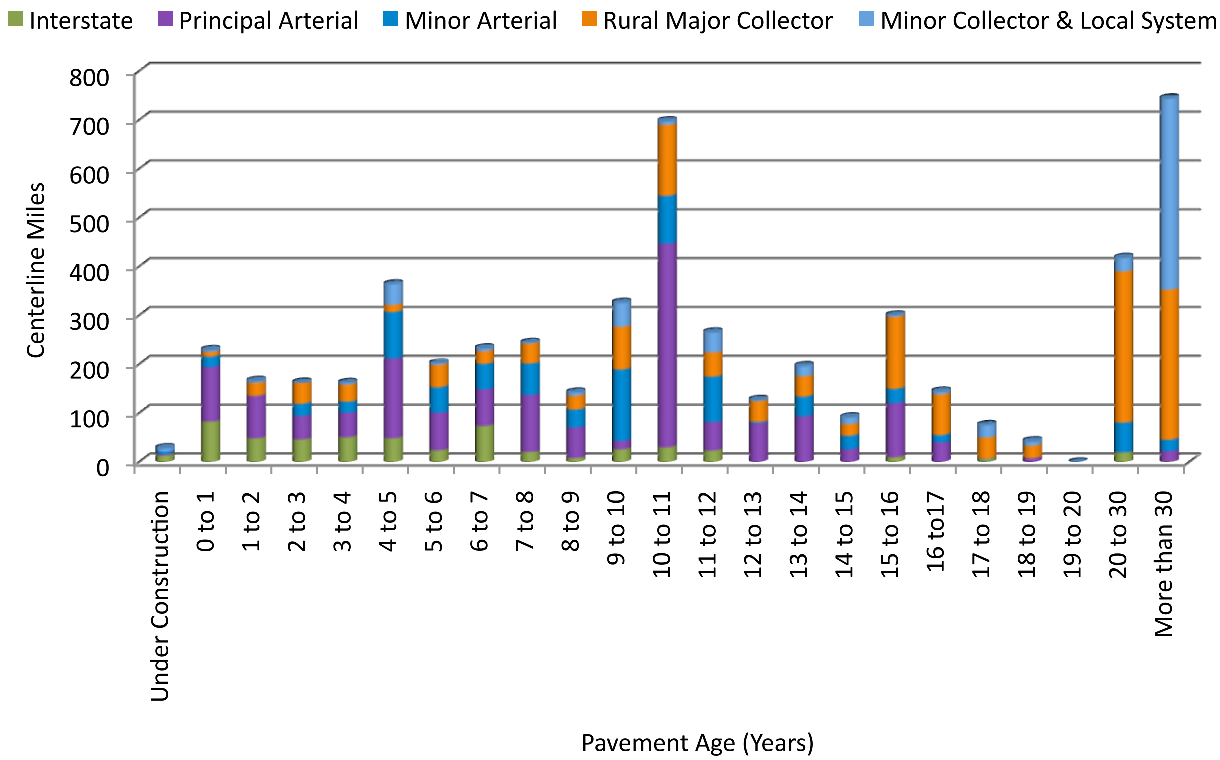


FIGURE 6: Pavement Age Distributions by Functional Class (As of November 2009)

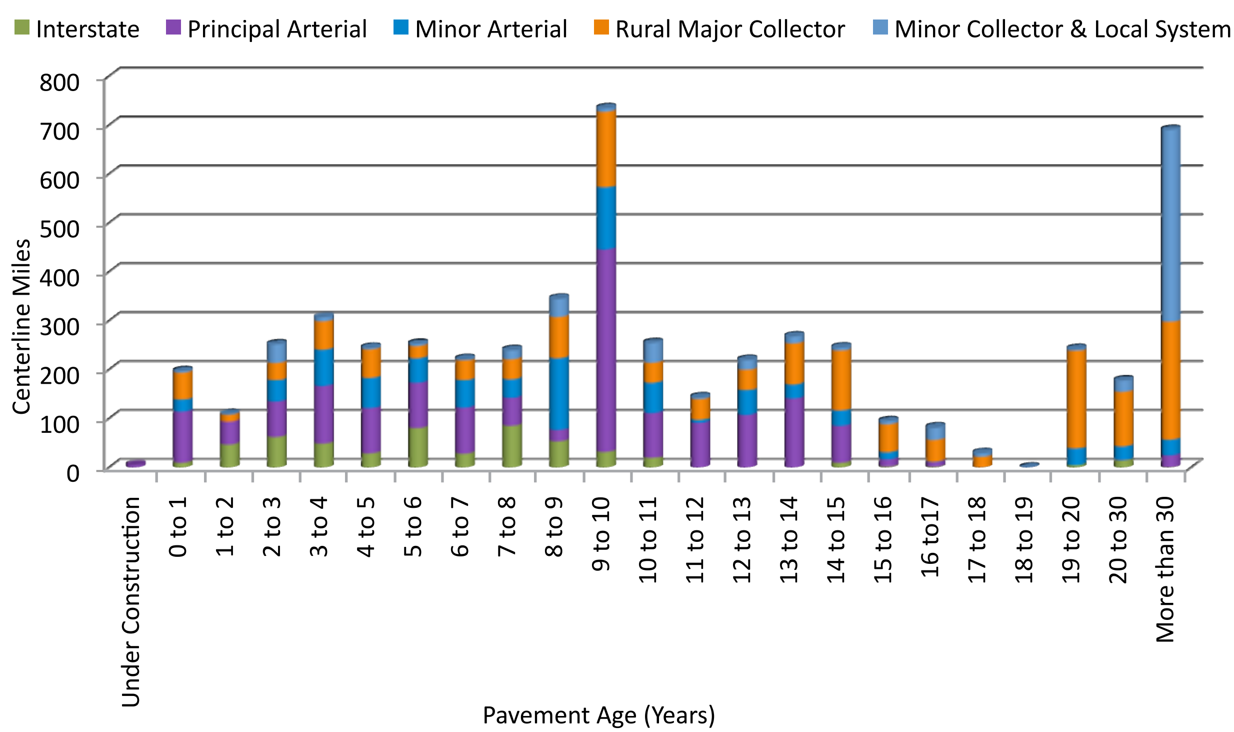


FIGURE 7: Pavement Age Distributions by Functional Class (As of July 2008)

The maintenance and rehabilitation for many of the Principal Arterial, Minor Arterial, and Rural Major Collector roads that are at least 10 to 20 years old will need to be deferred due to budget constraints. This pavement aging trend will continue until additional funding is made available for pavement preservation efforts.

Network Condition

(How do we assess the health of our pavement?)

The condition or "health" of the roadway network is determined by pavement roughness and distress data. Pavement roughness is measured by specialty equipment using a global standard called the International Roughness Index (IRI). Roughness is the distortion of the pavement surface that results in an uncomfortable ride. Distresses include various types of cracking, surface deformation such as rutting, and surface defects such as flushing or raveling. The type, extent, and severity of the distress data in combination with IRI measurements determine the current condition or "health" of the network.

New pavement exhibits excellent characteristics such as very smooth ride and no surface defects. As the pavement deteriorates and the ride becomes rough, it is necessary to spend an increasing amount of funds to maintain and rehabilitate the pavement to an acceptable level of service. The type, extent, and severity of the pavement distresses and roughness warrants what type of repair strategies are required to maintain or rehabilitate roads to acceptable levels of service. NDOT has divided its pavement preservation options into four main types of repair categories based on the pavement condition. These repair categories assist with the planning, budgeting, and scheduling of activities necessary for the preservation of the roadway network. Repair categories include:

- **Preventive Maintenance Surface Treatments:** Preventive maintenance surface treatments are applied early in the pavement service life when the ride quality is still good and there are few surface distresses. Preventive treatments are usually applied when an asphalt pavement is 3 to 4 years old and concrete pavement is less than 10 years old. Preventive treatments are applications or repairs that protect the road surface but do not improve the ride quality. Examples include fog or flush seals for asphalt pavement and the resealing of joints for concrete pavement.

- **Corrective Maintenance:** Corrective maintenance repairs are performed when preventive treatments are no longer effective and pavement surface distresses are apparent. Corrective maintenance is typically conducted when an asphalt pavement is 5 to 19 years old and a concrete pavement is 11 to 17 years old. Corrective maintenance consists of applications or repairs that protect the road surface without improving the load-bearing capacity. Examples include chip or slurry seals, filling potholes, and patching for asphalt pavement and the saw/seal of joints, spall repair, and slab jacking for concrete pavement.

- **Overlay:** Overlays are used on asphalt pavement when the pavement is in fair condition to prevent the pavement from deteriorating to a point when more expensive major rehabilitation or reconstruction strategies are required. Overlays are placed when asphalt pavement is 8 to 20 years old. Overlays are required for both functional and structural purposes. Examples include proactive overlays of 2 to 3 inches for functional purposes such as smoothness requirements and thick overlays of 4 inches or greater for structural purposes such as pavement stability.

- **Reconstruction:** Reconstruction or major rehabilitation occurs when a pavement is in such condition that overlays are no longer effective and the pavement is in poor to failed condition. Examples include roadbed modification or full-depth replacement of the pavement structural section for asphalt pavement and rubblization for concrete pavement.

Pavements in the preventive and corrective maintenance repair categories have less roughness and distress and in much better condition than pavements in the overlay and reconstruction repair categories. The costs for the overlay and reconstruction work required to upgrade roads to acceptable levels of service are far greater than the costs for preventive and corrective maintenance work.

Network Condition Based on Age

(What is the condition of our pavement?)

Pavement roughness and distress data are good indicators of the condition or “health” of the roadway network. Recommended repair categories are based on the condition of the pavement. In addition to these indicators, pavements can be assigned to a repair category based on age and functional class since pavements with similar characteristics usually deteriorate at similar rates. Therefore, the age and functional class of a pavement is also a good indicator of the type of preservation or rehabilitation work that the pavement currently requires. TABLE 3 summarizes network condition based on age and functional class. The table lists the number of miles that are required to improve the roadways to acceptable levels of service for each repair category. Approximately 46% of the pavements require corrective maintenance applications or repairs. These pavements will eventually deteriorate into conditions that require overlay repair strategies. FIGURE 8 and FIGURE 9 illustrate the same information in graphical format. The figures identify the amount of repair work required to preserve or improve the network to acceptable levels of service based on functional classes and repair categories. Low-volume road mileage is included in the table and figures. However, low volume pavement conditions are based on roughness and distress data not based on age.

TABLE 3: Pavement Condition on the State Maintained System - 2011

By Repair Strategy Required (Based on 2009 Pavement Age and 2007 Condition Data)

Centerline Miles

Repair catagories	Preventive Maintenance		Corrective Maintenance		Overlay		Reconstruction		Total	
System Description	**Miles**	**%**	**Miles**	**%**	**Miles**	**%**	**Miles**	**%**	**Miles**	**%**
Principal Arterial-Interstate	233	4.4%	152	2.9%	87	1.6%	86	1.6%	558	10.5%
Principal Arterial-Non Interstate	381	7.2%	663	12.5%	217	4.1%	406	7.6%	1667	31.4%
Minor Arterial	268	5.0%	496	9.3%	45	0.8%	105	2.0%	913	17.2%
Major Collector	399	7.5%	862	16.2%	159	3.0%	205	3.9%	1624	30.6%
Minor Collector and Local	50	0.9%	284	5.3%	98	1.9%	117	2.2%	549	10.3%
Total	1331	25.1%	2456	46.2%	606	11.4%	919	17.3%	5312	100.0%

Lane Miles

Repair catagories	Preventive Maintenance		Corrective Maintenance		Overlay		Reconstruction		Total	
System Description	**Miles**	**%**	**Miles**	**%**	**Miles**	**%**	**Miles**	**%**	**Miles**	**%**
Principal Arterial-Interstate	1030	7.9%	627	4.8%	349	2.7%	353	2.7%	2359	18.1%
Principal Arterial-Non Interstate	1053	8.1%	1586	12.2%	461	3.5%	947	7.3%	4047	31.1%
Minor Arterial	590	4.5%	1265	9.7%	128	1.0%	250	1.9%	2232	17.2%
Major Collector	805	6.2%	1729	13.3%	317	2.4%	415	3.2%	3267	25.1%
Minor Collector and Local	101	0.8%	569	4.4%	197	1.5%	240	1.8%	1107	8.5%
Total	3580	27.5%	5775	44.4%	1452	11.2%	2205	16.9%	13013	100.0%

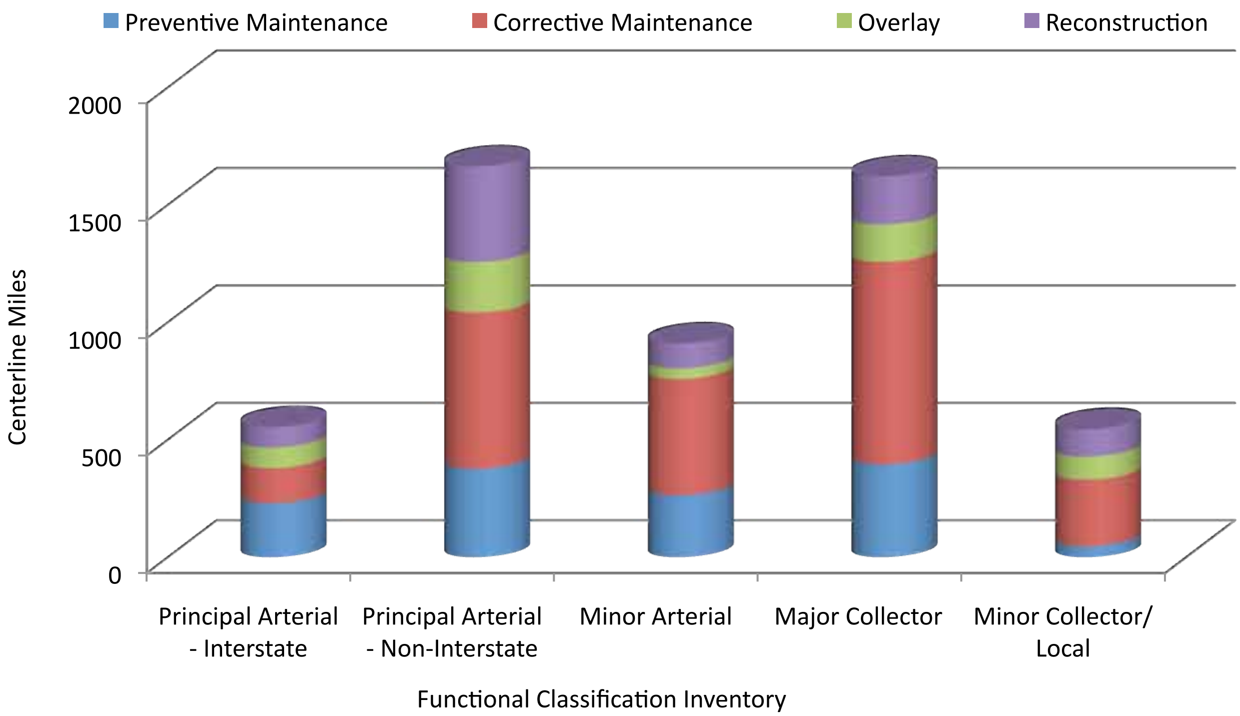


FIGURE 8: Network Condition Based on Age by Functional Classification

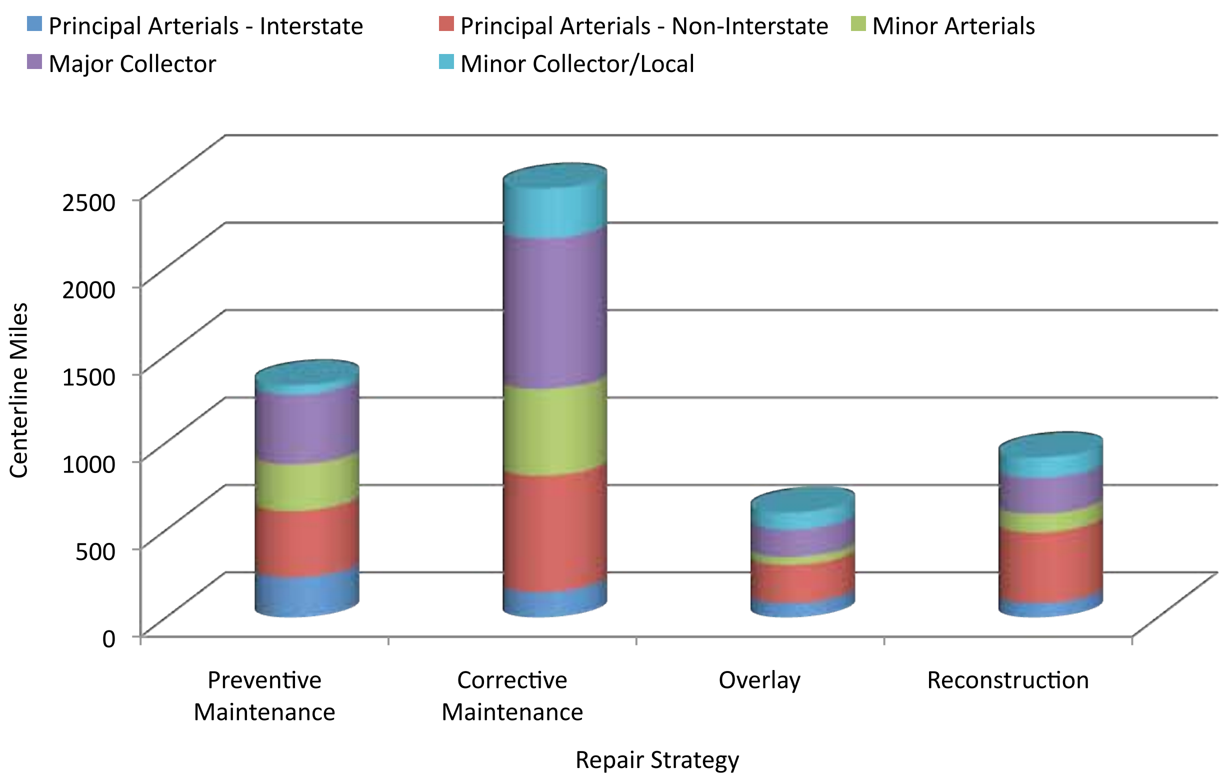


FIGURE 9: Network Condition Based on Age by Repair Category

Network Condition History

(How has our pavement condition changed?)

FIGURE 10 demonstrates the change in condition of the state-maintained roadway network based on repair categories since 1987. A significant rehabilitation program in 1999 and 2000, along with a proactive action plan that has been used since 1999, caused most pavements to remain in the preventive and corrective repair categories. However, the network is aging and will soon require overlay or reconstruction repair strategies. The amount of pavement that requires an overlay has been fairly consistent since 2003, but an increase in 2011 can be seen in FIGURE 10. Unfortunately, the amount of pavement that requires reconstruction has been increasing since 2005.

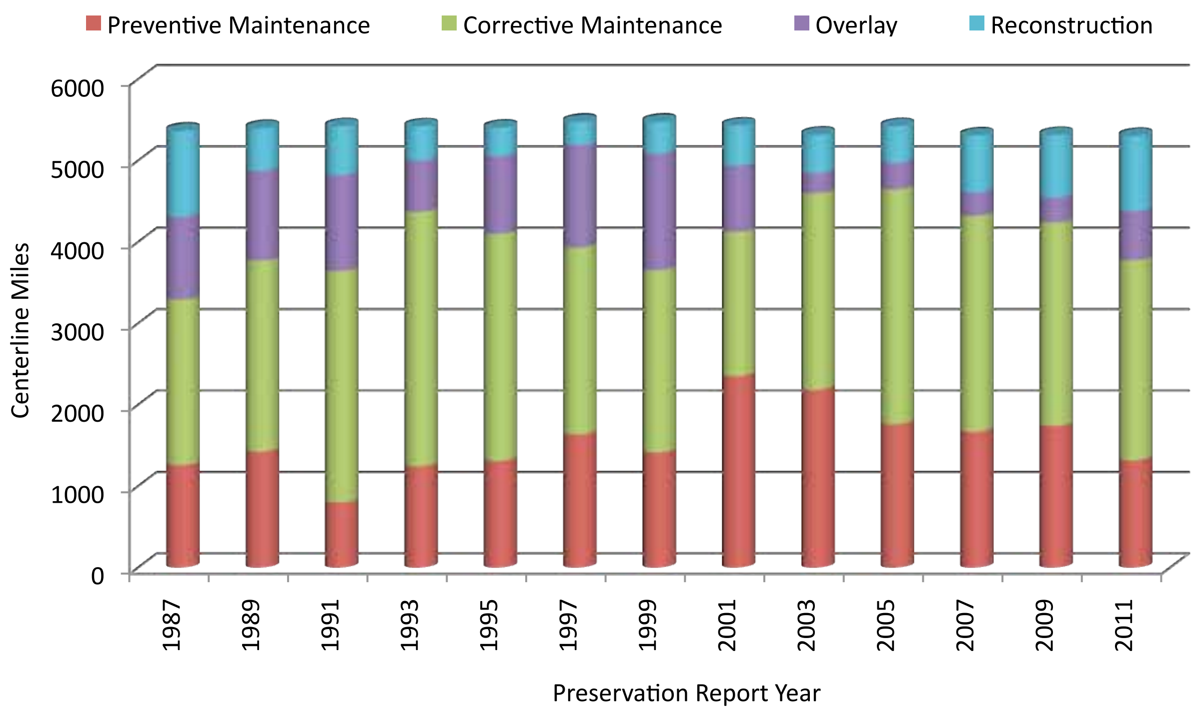


FIGURE 10: Pavement Condition over Time – 1987 to 2011

THE COST OF ROUGH ROADS

(What cost is imposed on roadway users due to poorly maintained pavements?)

Highway user costs rise when roads deteriorate and become rough. Rough roads cause increased vehicle operating costs. These additional operating costs include accelerated vehicle depreciation, additional vehicle repair, increased fuel consumption and increased tire wear.

Another consequence of rough roadways is uncomfortable ride. Recently published TRIP report indicates that Nevada motorists pay an additional $362 million annually because of rough roads.

Nevada is a bridge state in freight movement. Because of this reason, Nevada's highways get enormous amount of truck traffic. Poor road conditions will impact the economies of the trucking industry and will have an impact in the final cost of the commodity being transported. Also significant part of Nevada's economy depends on the visitors to the state. Unfavorable road conditions will repel the visitors and divert them to other states for their recreational needs.

Federal Highway administration estimates that each dollar spent on road and bridge improvement results in an average benefit of $5.20 in the form of reduced vehicle maintenance costs, reduced delays, reduced fuel consumption, improved safety, reduced road and bridge maintenance costs and reduced emissions as a result of improved traffic flow.

An analysis of federal Highway administration in 2007 found that every $1 billion invested in highway construction would support approximately 27800 jobs, including approximately 9,500 in the construction sector, 4,300 jobs in industries supporting the construction sector and 14,000 other jobs induced in non-construction related sectors of the economy.

PRESERVATION METHODS

(What are the preservation actions? How do we select the appropriate action?)

Roads in very rough or poor condition are past the point in time when less expensive preventive and corrective maintenance or thin overlays are effective to preserve and maintain the roads in good condition. When roads are allowed to deteriorate into poor condition, more invasive and expensive major rehabilitation or reconstruction practices are required. NDOT adopted proactive pavement management practices many years ago and works hard to prevent roads from deteriorating to a point where major rehabilitation or reconstruction is required. This philosophy lowers pavement life-cycle costs and better serves the traveling public.

As shown in Figure 11, it can cost six times or more to reconstruct a road in very poor condition rather than maintaining the road in good condition by applying timely maintenance and thin overlay rehabilitation treatments.

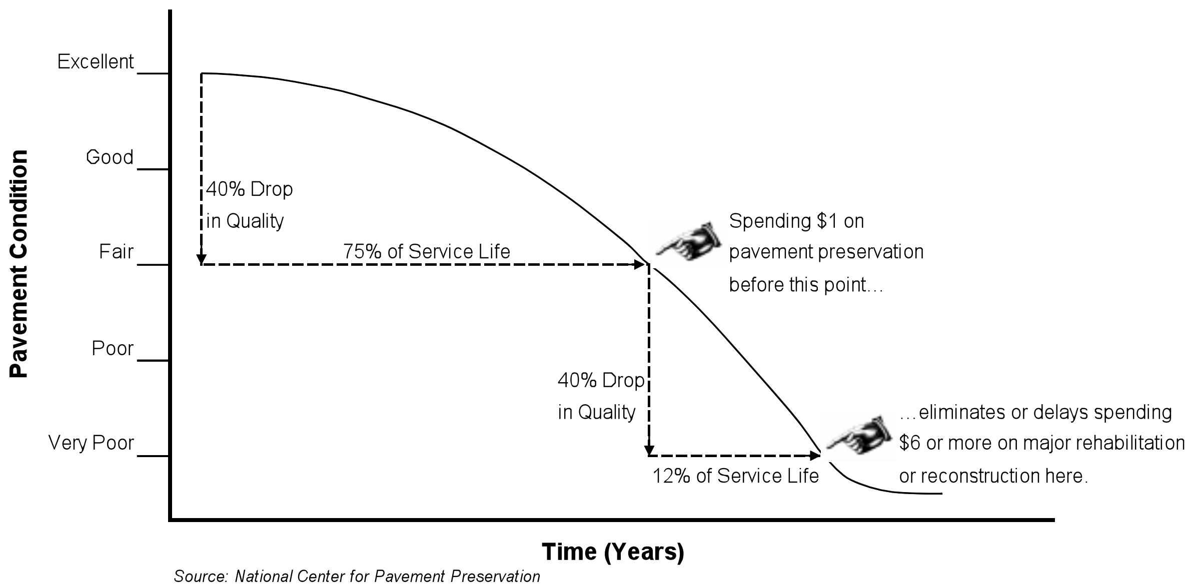


FIGURE 11: Typical Pavement Deterioration Curve

The expected service life for asphalt pavement is a function of many parameters. The parameters having the most consequence are the road roughness and amount of truck loadings that the pavement is expected to experience. NDOT has grouped the pavement network into five major road categories. The pavement in each category share similar characteristics, deterioration patterns, truck loadings, and predicted distress rates. These network level divisions allow pavement managers to anticipate the average optimal timings for each type of preservation repair category that NDOT employs. These major road categories should not be confused with the functional classification inventory as each grouping type serves a separate and distinct purpose for pavement management purposes.

TABLE 4 presents the typical windows of opportunity for applying preventive, corrective, and proactive thin overlay repair strategies to preserve roads in fair to good condition as opposed to the timing when major rehabilitation or reconstruction is required and project costs soar. For example, an Interstate highway will need a proactive thin overlay at an average of every eight years to maintain the pavement in good condition whereas a low-volume road will need a proactive thin overlay at an average of every twenty years to maintain the pavement in good condition. Proactive thin overlays cost far less than allowing the pavement to deteriorate into a very poor condition when reconstruction is the only repair option. Cost comparisons between timely placed proactive overlays and a complete reconstruction are based on long-term life cycle costs that include initial construction and all rehabilitation and maintenance treatments required to extend the pavement service life through the analysis period.

TABLE 4: Optimal Timing for Pavement Repair Strategies on Major Road Categories

Controlled-access highways, National Highway System routes, and non-controlled-access highways

		Repair Strategy (based on pavement age in years)			
Roadway Categories	**Pavement Type**	**Preventive Maintenance**	**Corrective Maintenance**	**Overlay**	**Reconstruction**
Interstates, Freeways, and All Other Controlled-Access Highways	AC	Age ≤ 4 yrs.	4 < Age < 8 yrs.	Age = 8 yrs.	Age > 8 yrs.
	PCC	Age ≤ 10	10 < Age < 18	N/A	Age > 18
Non-Controlled-Access Highways with: ADT>10,000 or ESAL>540	AC	Age ≤ 4	4 < Age < 10	Age = 10	Age > 10
Non-Controlled-Access Highways with: 1,600<ADT≤10,000 or 405<ESAL≤540 And National Highway System routes with ADT≤10,000	AC	Age ≤ 4	4 < Age < 12	Age = 12	Age > 12
Non-Controlled-Access Highways off the National Highway System with: 400<ADT≤1,600 or 270<ESAL≤405	AC	Age ≤ 4	4 < Age < 15	Age = 15	Age > 15
Non-Controlled-Access Highways off the National Highway System with: ADT≤400	AC	Age ≤ 4	4 < Age < 20	Age = 20	Age > 20

Notes: ADT = Average Daily Traffic (in vehicles per day)

ESAL = Equivalent 18,000-pound Single-Axle Loads imparted daily. It takes 2,500 cars to impart a single ESAL but just one fully-loading two-axle delivery truck.

AC - Asphalt Concrete, PCC – Portland Cement Concrete

Cost Savings for a Proactive Project-level Case Study

(Real example based on two NDOT construction Projects)

Significant savings can be realized using the proactive strategy of maintaining roads in fair to good condition and not allowing the roads to deteriorate to very poor condition when a major rehabilitation or reconstruction repair option is required. One example of proactive pavement management is a project-level case study of a 12-mile section of I-80 between the California-Nevada state line and Reno. The road had a severely deteriorated pavement condition when it was rehabilitated in 1994. Prior to the 1994 reconstruction, the road was rehabilitated in 1982. The rehabilitation strategy in 1994 was to cold mill 4-in. and place a 5-in. asphalt overlay. The cost for the work was $9.6 million. In 2002, the same length of road was prioritized based on the financial consequences of a proactive thin asphalt overlay. The cost of the 2002 construction work was $6.2 million, which is actually $7 million less than the 1994 rehabilitation price when costs are adjusted for inflation. The difference in the present-worth cost of placing the thin overlay every eight years at $400,000 per centerline mile compared to the major rehabilitation every 12 years at $1 million per centerline mile is $600,000 per centerline mile. This conclusion is based on a 20-year analysis period and a 4% discount rate.

There is a significant cost saving for the State when funding is made available to proactively manage pavement. This proactive management technique of placing thin overlays when roads are in fair condition and not allowing roads to deteriorate into poor condition is overwhelmingly responsible for the reduction in project backlog reported at $528 million in 1999 and $287 million in 2005. The reduction in project backlog occurred despite below-average project expenditures during the four fiscal years from 2001 through 2004.

PROJECT PRIORITIZATION

(How do we select individual projects that assure efficient utilization of limited financial resources?)

The pavement preservation program competes for funding with capacity improvement, operations, bridge, hydraulic, and safety projects and programs. Since available funding is never unlimited, the PMS is the perfect tool to help engineers prioritize projects in such a manner that will improve the condition of the entire roadway network while maximizing pavement performance and keeping costs to a minimum.

The rationale used to prioritize pavement preservation projects is based on financial consequences as depicted in the typical pavement deterioration curve in FIGURE 11. The curve demonstrates that there will be a large difference in cost between spending funds on preservation when roads are in fair condition versus spending funds on reconstruction when roads are in very poor condition. The greater the difference in cost to maintain a road in fair condition versus the cost of complete reconstruction, the higher the priority that particular pavement segment receives for prioritization. For example, Interstate highways have been identified as the road type with the highest priority because the financial consequences of not maintaining this portion of the network in fair condition are the greatest. Delaying a rehabilitation project on the Interstate by one or two years will typically add several million dollars to rehabilitation costs. This type of road should be evaluated on an eight year proactive schedule and will deteriorate faster than low volume roads, which are on a 15 to 20 year proactive evaluation schedules.

STATE PAVEMENT PRESERVATION FUNDING

(How do we fund State pavement preservation?)

The State's roadway network is predominantly financed by highway user taxes such as fuel taxes and vehicle registration fees. During the last two fiscal years, $360 million was invested in pavement preservation work. This expenditure included the one time funding of $123 million provided by American Recovery and Reinvestment Act (ARRA). Pavement preservation work included approximately $221 million investment of federal funds, $137 million investment of state funds, and $1 million other funds. Approximately $284 million was contracted out to private contractors and $76 million was performed by NDOT maintenance forces. Overlay and reconstruction were accomplished by general road contractors and most preventive and corrective maintenance treatments were accomplished by NDOT state force. FIGURE 12 displays the funding source and construction expenditure information.

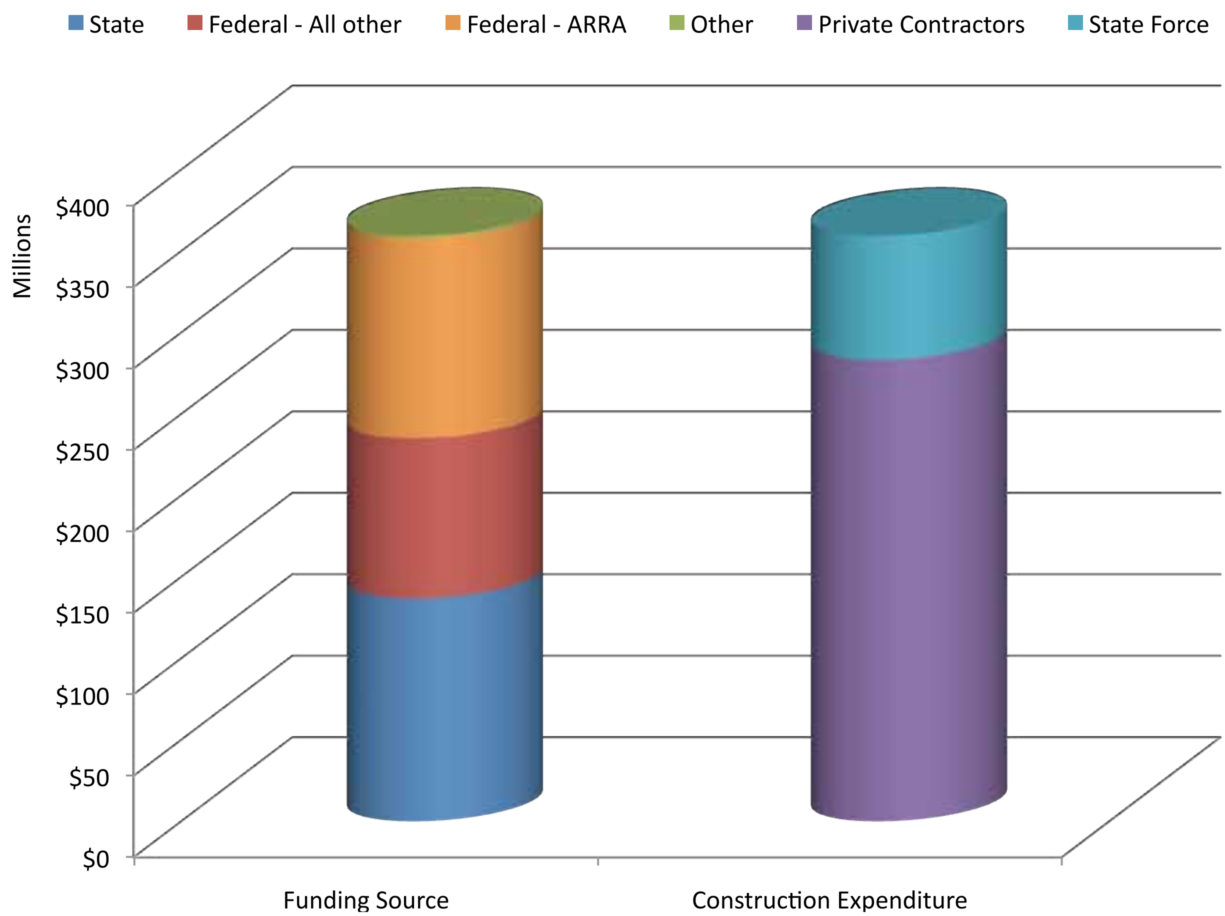


FIGURE 12: Biennial Pavement Preservation Funding and Spending – 2009 and 2010

Biennial Expenditures for Fiscal Years 2009 to 2010

(What have we expended on pavements in the last two years?)

During fiscal years 2009 and 2010, NDOT obligated $268 million for pavement overlay and reconstruction repair projects. These expenditures addressed the preservation needs for 383 miles of roads. This is an expenditure of $100 million more than the previous biennium and approximately 200 more miles of roads received overlay and reconstruction work. The additional repairs were due to competitive bids for construction work and resulting low costs.

TABLE 5 summarizes expenditures and corresponding mileage of repair strategies for fiscal years 2009 and 2010. FIGURE 13 and FIGURE 14 highlights the roadway sections that received overlay and reconstruction repair work during the 2009 and 2010 biennium.

TABLE 5: Pavement Expenditures and Miles of Highway Overlaid and Reconstructed
(Fiscal Years 2009 and 2010)

Fiscal Year	Repair Strategy						
	Preventive & Corrective Maintenance	Overlay		Reconstruction		Total	
	Expenditures	Expenditures	Miles	Expenditures	Miles	Expenditures	Miles
2009	$25,307,939	$149,243,399	175.2	$2,491,080	2.4	$151,734,479	178
2010	$19,993,906	$113,691,231	203.7	$2,335,745	1.4	$116,026,976	205
Biennium Total	$45,301,846	$262,934,630	378.9	$4,826,825	3.8	$267,761,455	383

Costs of Construction

(How much pavement construction can be done with the current fuel taxes?)

Highway construction costs depend on energy prices and recent spikes in energy prices have significantly increased preservation costs. The State Highway Fund gasoline tax of 17.65 cents per gallon in 1992 has the highway construction purchasing power of 6.88 cents in 2010 because of inflation in construction costs. The average 2010 western states construction costs were approximately 260% that of 1992. The construction cost index measures the price development of labor, materials, transport, and other input factors in the production of highway projects. A steep rise in the construction cost index for the western states was observed between 2003 and 2008 when energy prices skyrocketed nationally. Locally, prices of gasoline exceeded $4 per gallon in July of 2008. Since July 2008, fuel prices have declined, and now fluctuate at approximately $3.00 per gallon.

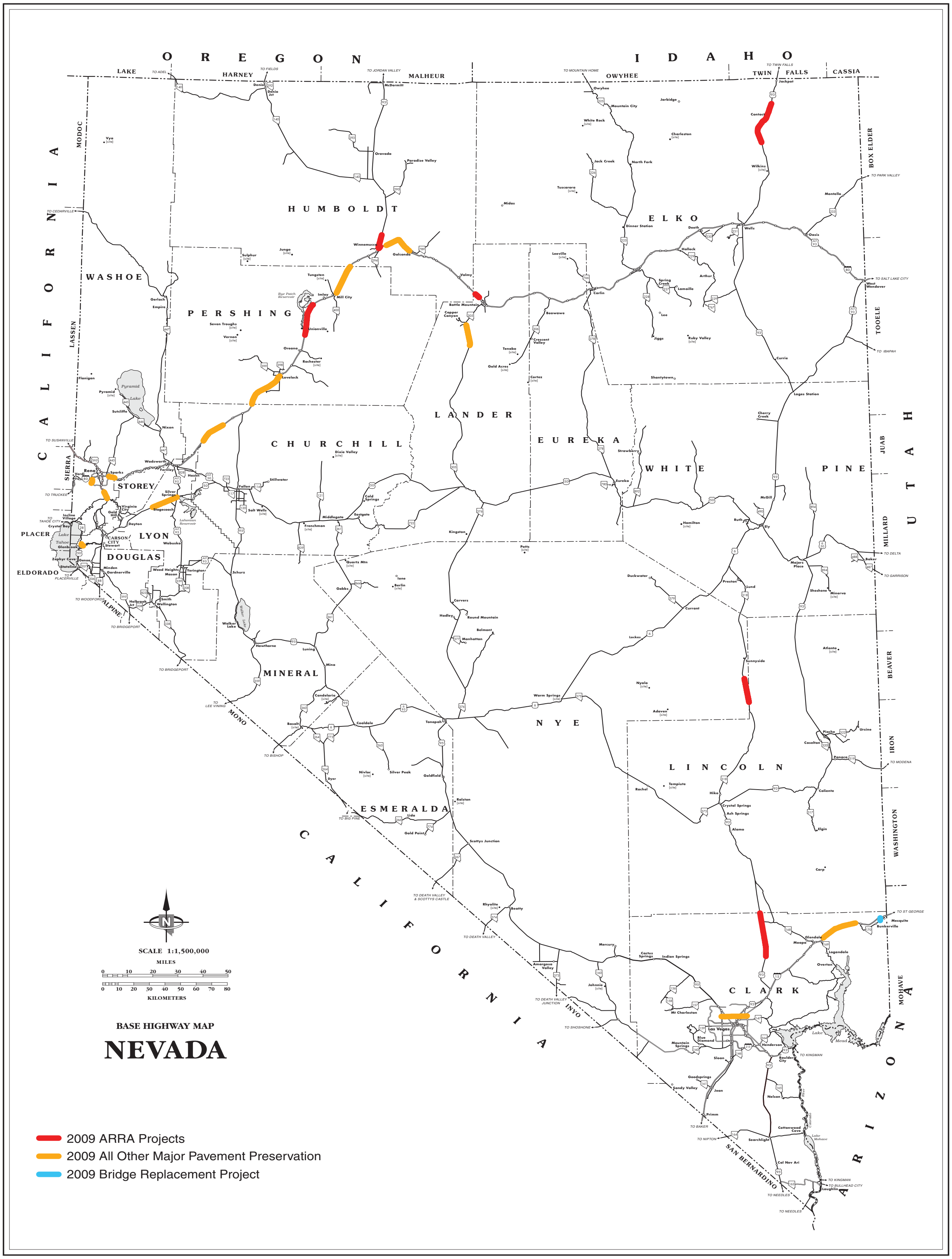


FIGURE 13: Overlay and Reconstruction Projects Advertised in Fiscal Year 2009

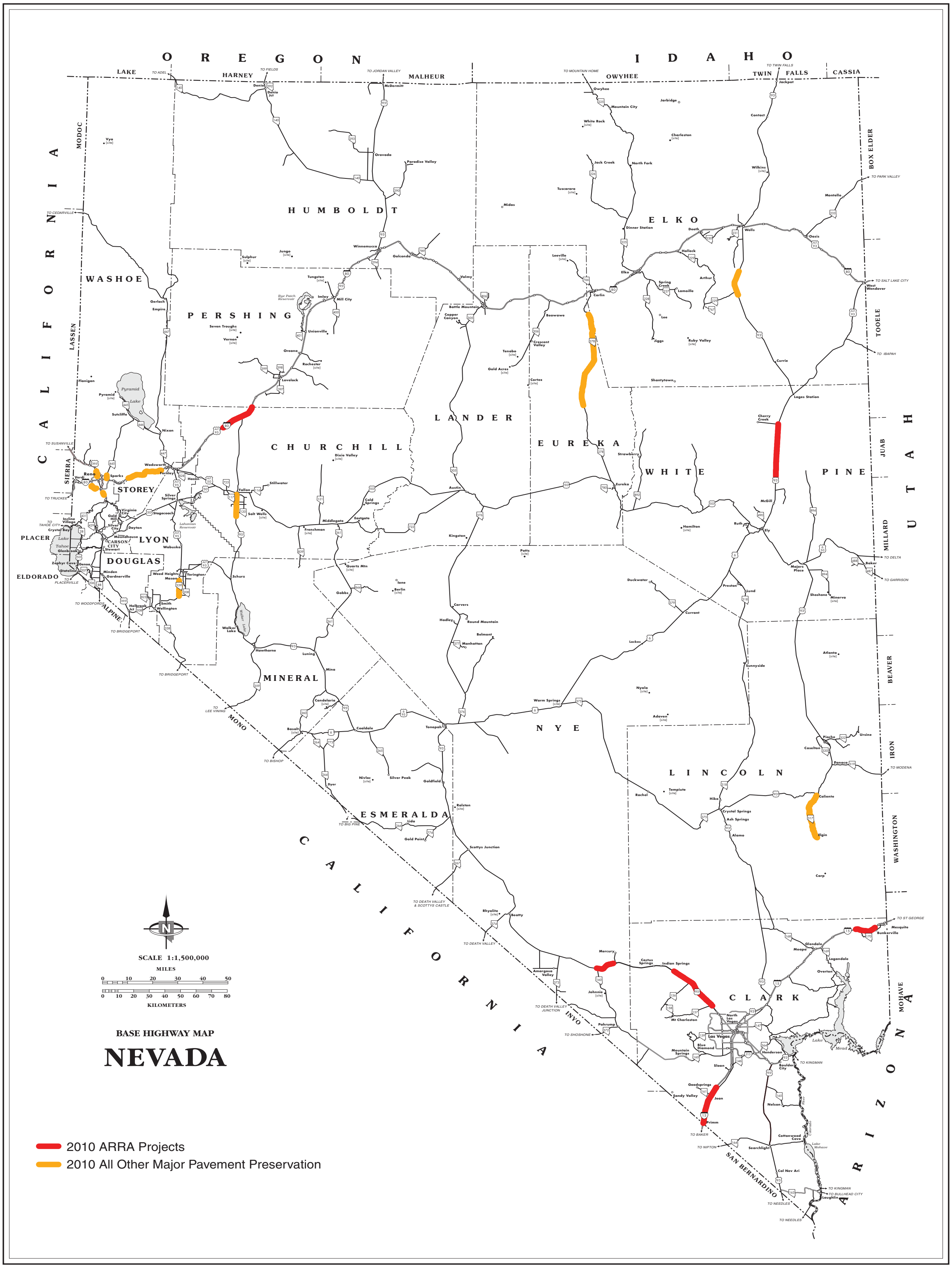


FIGURE 14: Overlay and Reconstruction Projects Advertised in Fiscal Year 2010

FIGURE 15 shows the average of construction cost indices for the Western States since 1990. The average construction cost index increased 183% from 2003 through 2010.

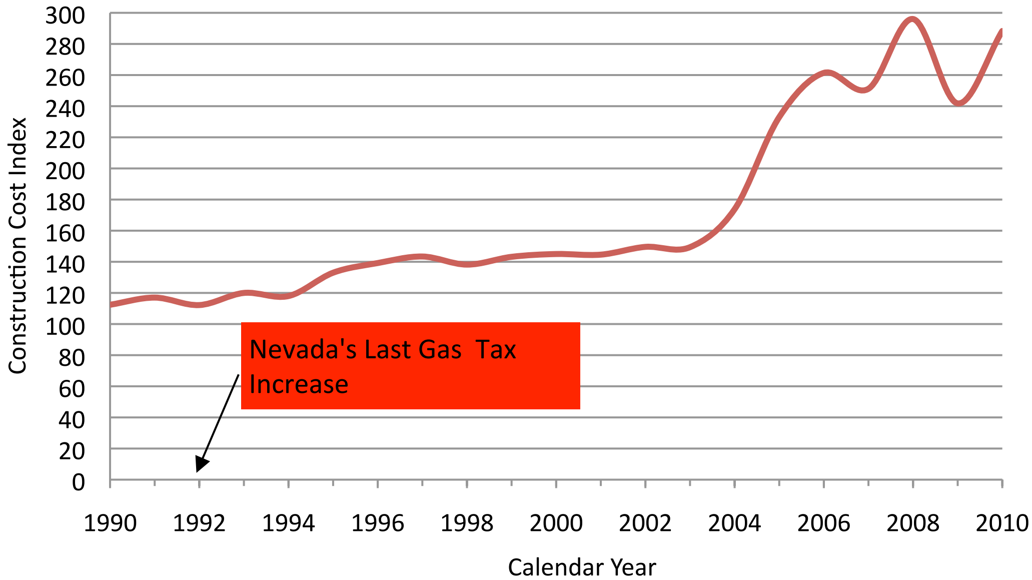


FIGURE 15: Average of the Construction Cost Indices of California, Colorado, Oregon, Utah, and Washington.

FIGURE 16 shows the pavement overlay cost trend over the years for the state-maintained network.

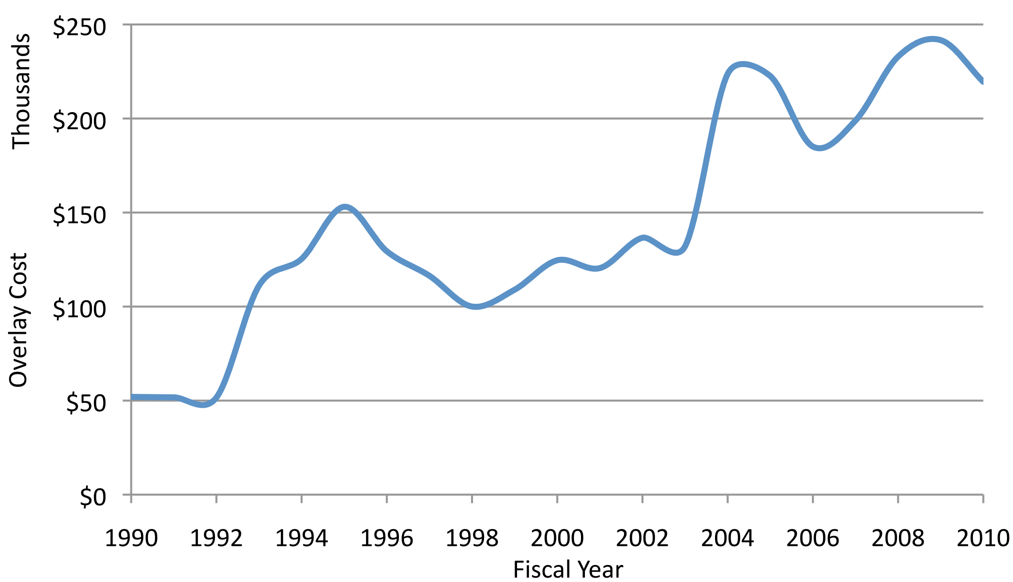


FIGURE 16: Pavement Overlay Costs over Time

Construction prices were slightly depressed in 2006, but increased with overall inflation until 2009. Pavement overlay costs declined in 2010 by approximately 10% compared to 2009. An excessively large increase in the construction cost index and corresponding pavement overlay costs without a proportionate increase in pavement preservation revenue has made the proactive management of the state-maintained roadway network difficult to sustain. NDOT's long-term proactive pavement management plan will only be effective if adequate funding is made available to apply proactive thin overlays on a timely basis before roads deteriorate to a condition where expensive reconstruction repair methods are required.

BACKLOG OF PAVEMENT PRESERVATION WORK

(What will it cost to bring the pavement to excellent condition?)

NDOT's long-term proactive pavement management plan is to maintain the entire pavement in fair to good condition in order to reduce the need for more expensive major rehabilitation and reconstruction repair methods. Since this optimized plan is not possible due to current funding constraints, the amount of overlay and reconstruction project backlog is assessed. Pavement in the preventive and corrective repair categories is not included in the backlog because this pavement is maintained with existing routine-maintenance funds. TABLE 6 identifies the amount of work required to preserve all pavement in good condition. The cost to eliminate the backlog of overlay and reconstruction repair work is approximately $1.2 billion.

TABLE 6: Backlog of Overlay and Reconstruction Work

State-Maintained System - 2011

	Overlay		Reconstruction		Total	
System	**Lane Miles**	**Cost**	**Lane Miles**	**Cost**	**Lane Miles**	**Cost**
Principal Arterial - Interstate	349	$76,608,448	353	$145,269,769	702	$221,878,216
Principal Arterial - Non-Interstate	461	$101,280,408	947	$389,244,091	1408	$490,524,499
Minor Arterial	128	$28,028,996	250	$102,642,011	377	$130,671,007
Major Collector	317	$69,653,381	415	$170,765,166	733	$240,418,547
Minor Collector & Local	197	$43,157,055	240	$98,796,256	437	$141,953,311
Total	1452	**$318,728,288**	2205	**$906,717,293**	**3,657**	**$1,225,445,581**

*The cost includes pavement, ancillary repairs, and engineering on projects. Ancillary repairs typically include repairing signs and signals, replacing traffic delineators, repairing ditches and culverts, and grading shoulders.

Available Funding Versus Needed Funding

(How much financial resources we have and what will it take to bring the entire pavement to excellent Condition?)

The current $1.2 billion of pavement preservation backlog will increase to $1.5 billion in 2015, and climb to $2.1 billion in 2023 with the present funding level. The funding required to eliminate the pavement preservation backlog will be $170 million per year over the next 12 years. FIGURE 17 illustrates comparison between the backlog if needs remain unfunded verses the backlog if additional funding becomes available. TABLE 7 summarizes the backlog increase if present funding levels continue and the additional revenue required to eliminate the backlog by 2023.

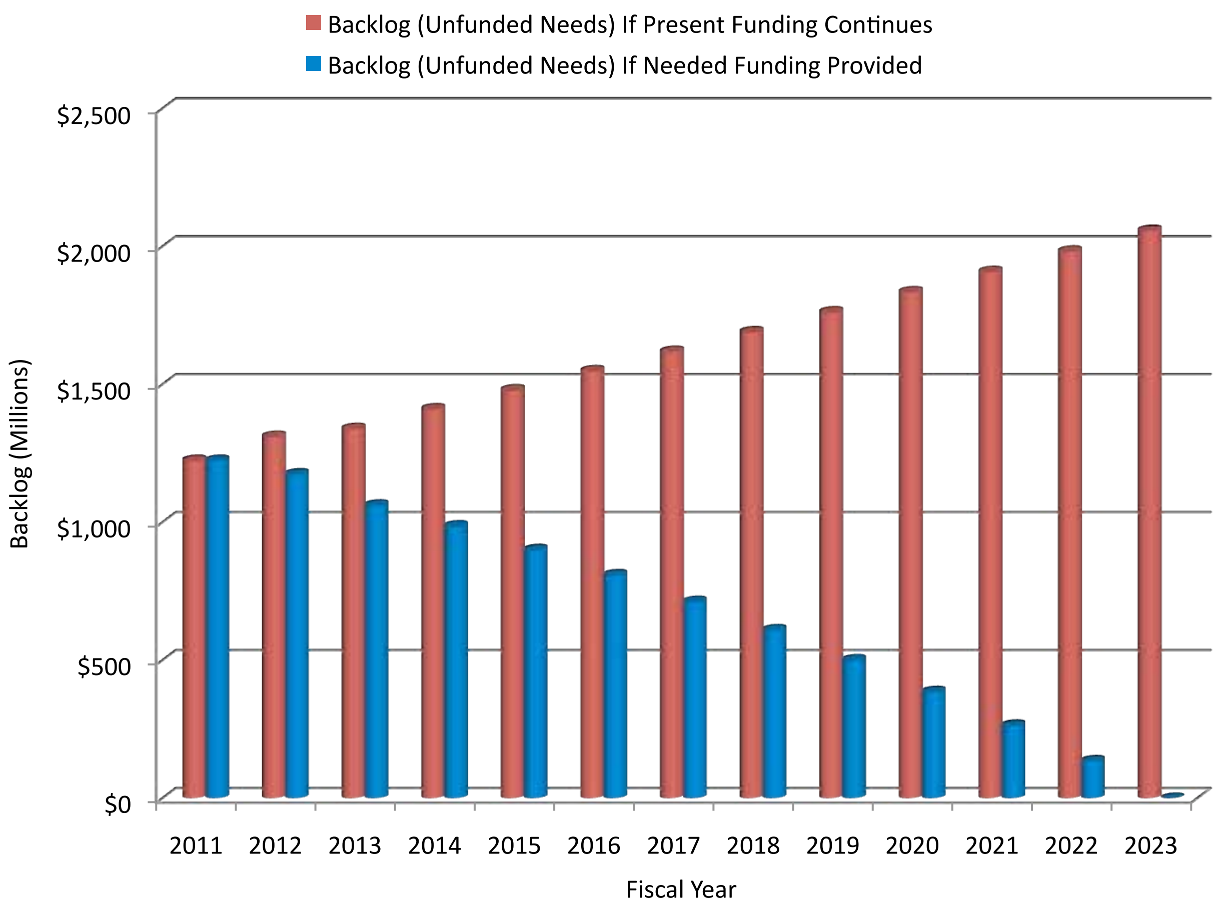


FIGURE 17: Backlog of Pavement Needing Overlay or Reconstruction with Present Funding vs. Needed Funding

TABLE 7 - Pavement Backlog, Costs, and Funding

State-Maintained System - 2011 - 2023 (in millions of dollars)

With Present Funding

		Pavement Preservation Costs * (Normal Annual Deterioration Costs)			Pavement Preservation Funds ** (Funds Planned for Preservation Work)				
Fiscal Year	**Backlog of Pavement Work**	Overlay and Reconstruction	Preventive and Corrective Maintenance	Total	State Overlay and Reconstruction	Federal Overlay and Reconstruction	State Preventive Maintenance		Total
2011	**$1,225.4**	181.7	22.7	204.4	48.9	45.9	22.7		117.5
2012	**$1,312.3**	156.6	23.3	180.0	58.8	69.4	23.3		151.5
2013	**$1,340.8**	182.5	24.0	206.5	51.1	59.8	24.0		134.9
2014	**$1,412.4**	184.2	24.8	209.0	55.1	60.7	24.8		140.5
2015	**$1,480.8**	189.8	25.5	215.3	57.3	63.1	25.5		145.9
2016	**$1,550.2**	195.5	26.3	221.7	59.6	65.7	26.3		151.5
2017	**$1,620.5**	201.3	27.0	228.4	61.9	68.3	27.0		157.3
2018	**$1,691.6**	207.4	27.9	235.2	64.4	71.0	27.9		163.3
2019	**$1,763.5**	213.6	28.7	242.3	67.0	73.9	28.7		169.5
2020	**$1,836.2**	220.0	29.6	249.5	69.7	76.8	29.6		176.0
2021	**$1,909.7**	226.6	30.4	257.0	72.5	79.9	30.4		182.8
2022	**$1,984.0**	233.4	31.4	264.7	75.4	83.1	31.4		189.8
2023	**$2,058.9**								

With Needed Additional Funding

		Pavement Preservation Costs * (Normal Annual Deterioration Costs)			Pavement Preservation Funds ** (Funds Planned & Needed for Preservation Work)				
					Existing				
Fiscal Year	**Backlog of Pavement Work**	Overlay and Reconstruction	Preventive and Corrective Maintenance	Total	State Overlay and Reconstruction	Federal Overlay and Reconstruction	State Preventive Maintenance	**Needed Additional Funds**	Total
2011	**1,225.4**	181.7	22.7	204.4	48.9	45.9	22.7	**136.0**	253.5
2012	**1,176.3**	156.6	23.3	180.0	58.8	69.4	23.3	**141.4**	292.9
2013	**1,063.4**	182.5	24.0	206.5	51.1	59.8	24.0	**147.1**	282.0
2014	**987.9**	184.2	24.8	209.0	55.1	62.2	24.8	**153.0**	295.0
2015	**901.9**	189.8	25.5	215.3	57.3	64.7	25.5	**159.1**	306.5
2016	**810.7**	195.5	26.3	221.7	59.6	67.3	26.3	**165.4**	318.5
2017	**713.9**	201.3	27.0	228.4	61.9	70.0	27.0	**172.1**	331.0
2018	**611.2**	207.4	27.9	235.2	64.4	72.8	27.9	**178.9**	344.0
2019	**502.5**	213.6	28.7	242.3	67.0	75.7	28.7	**186.1**	357.4
2020	**387.3**	220.0	29.6	249.5	69.7	78.7	29.6	**193.5**	371.5
2021	**265.4**	226.6	30.4	257.0	72.5	81.8	30.4	**201.3**	386.0
2022	**136.4**	233.4	31.4	264.7	75.4	85.1	31.4	**209.3**	401.2
2023	**0.0**								

* Inflation assumed at 3% per annum.
** Revenue growth rate assumed is 4% per annum.

Note: Backlog of pavement work is as of beginning of fiscal year; preservation costs are those incurred during the fiscal year; and preservation funds are those that are available during the fiscal year.

Financial Needs History

(What was the pavement preservation backlog in the past and how did they change over the years?)

FIGURE 18 demonstrates how the financial needs for pavement preservation have changed since 1987. Generally, the total needs increased with inflation until 1999 and decreased the following biennium because of an aggressive maintenance program in the late 1990s. In the last few years, abnormally high inflation in roadway construction costs has caused a dramatic increase in financial needs. Inflation coupled with less investment for pavement preservation is an assurance that financial needs will not decrease in the foreseeable future. FIGURE 19 identifies the financial needs for pavement repairs that are inflation-adjusted to 2010 dollars.

PAVEMENT PRESERVATION ACTION PLAN

(How will we improve our pavements? How do we prioritize available resources? What are the financial resources needed?)

Available funding for pavement preservation needs is uncertain for the immediate and distant future. Therefore, NDOT developed both short- and long-term action plans to ensure that funds will be invested in the most cost-effective manner possible. Greater demand on the existing roadway network, constrained resources, and heightened expectations from the traveling public are cause for very challenging times. There has never been a more critical time to plan and deliver services in an efficient manner.

Short-term Action Plan

(What will we do if there is no legislative action regarding preservation funding through fiscal year 2013?)

Although the following short-term action plan is not entirely proactive pavement management, the plan protects the most costly pavement assets such as the Interstate highways and Non-interstate Principal Arterial roads. Less traveled roads will be allowed to deteriorate into the reconstruction repair category because lack of funding does not allow implementing more proactive pavement management. If the Legislature cannot provide additional preservation funding through fiscal year 2023, the pavement backlog will rise from the current level of $1.2 billion to $2.1 billion in 2023.

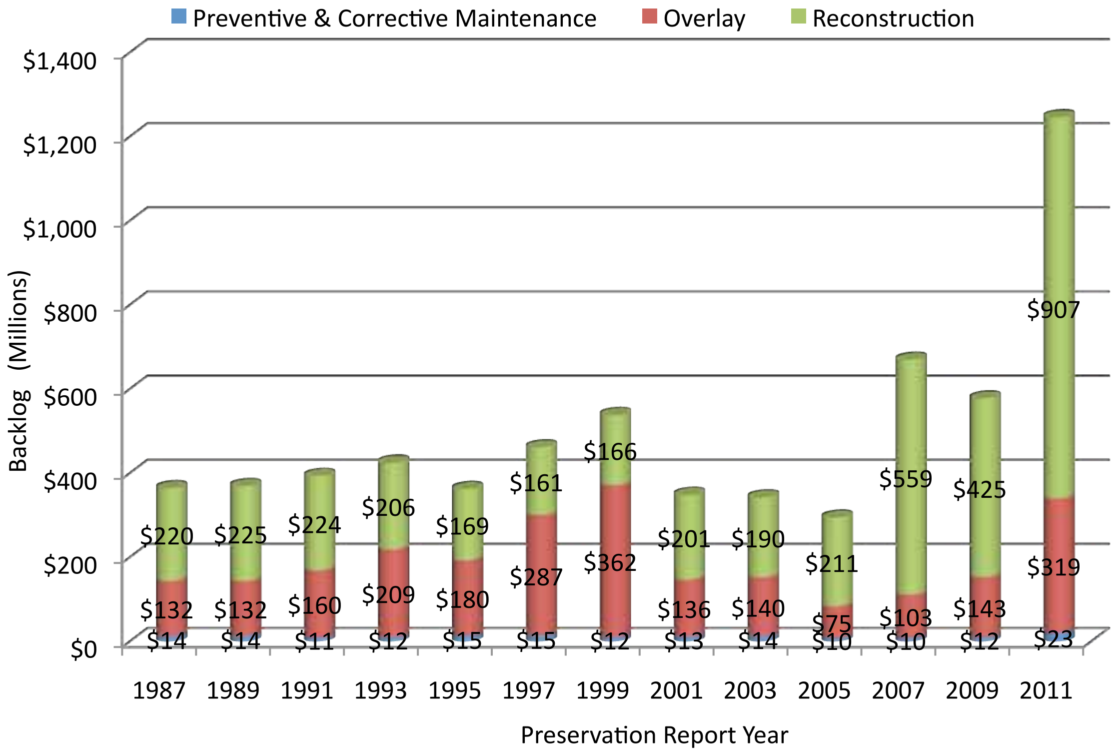


FIGURE 18: Status of Network by Cost of Repair Strategy Required – 1987 to 2011

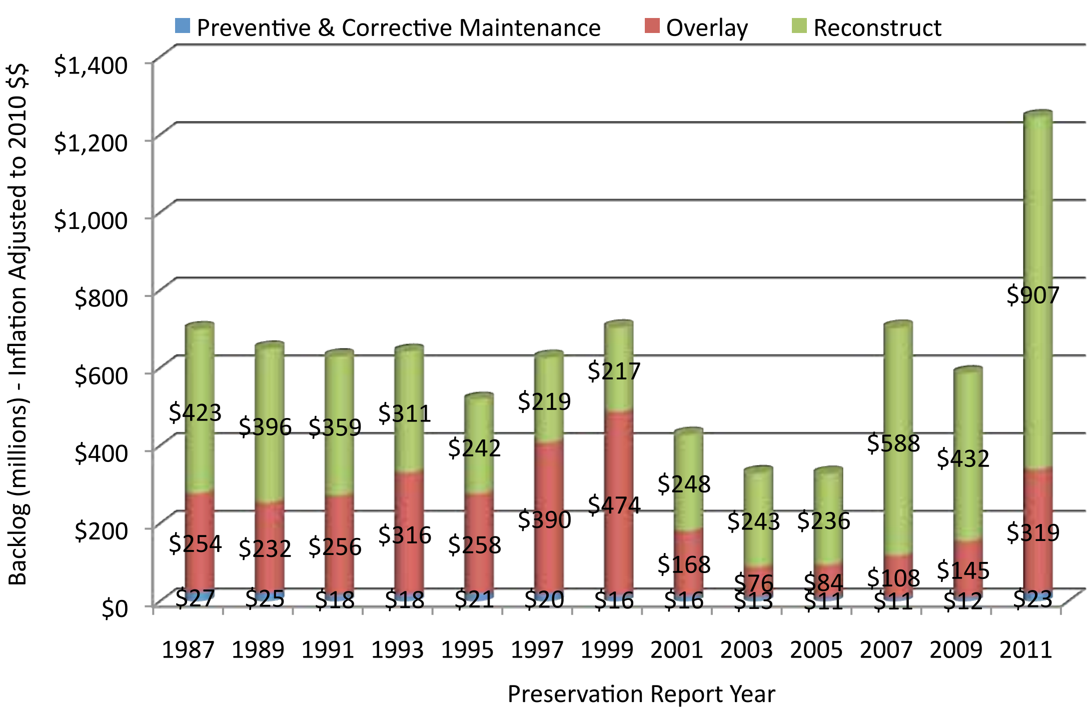


FIGURE 19: Status of Network by Composite Consumer Price Index – 1987 to 2011

The following pavement management practices will be implemented for the short-term action plan:

- Maintain the Interstate highways and Non-interstate Principal Arterial roads at a high level of service by the construction of proactive thin asphalt overlays as funding allows and reconstruction of inferior pavement segments as necessary.
- Apply preventive and corrective maintenance treatments and repairs to other routes as funding allows.

Long-term Action Plan

(What will we do if legislators acted to increase preservation funding?)

NDOT's long-term action plan includes the proactive philosophy of applying thin asphalt overlays at appropriate intervals based on the rate of pavement deterioration. Thin asphalt overlays prevent the network from deteriorating into the need for more costly repairs. The long-term action plan relies on the Legislature to adequately fund preservation needs. The following pavement management practices will be implemented for the long-term action plan (if adequate funding is provided):

- Maintain the Interstate highways and Non-interstate Principal Arterial roads at a high level of service by the construction of proactive thin asphalt overlays as funding allows and reconstruction of inferior pavement segments as necessary.
- Preserve the Minor Arterial, Major Collector, and Minor Collector roads at an adequate to good level of service by the construction of proactive thin asphalt overlays as funding allows and reconstruction of inferior pavement segments as necessary.
- Manage the low-volume roads at a minimal and acceptable level of service by application of preventive and corrective maintenance treatments and repairs.

FIGURE 20, FIGURE 21, and FIGURE 22 highlights the overlay and reconstruction projects anticipated to be constructed with fiscal year 2011, 2012, and 2013 funds, respectively.

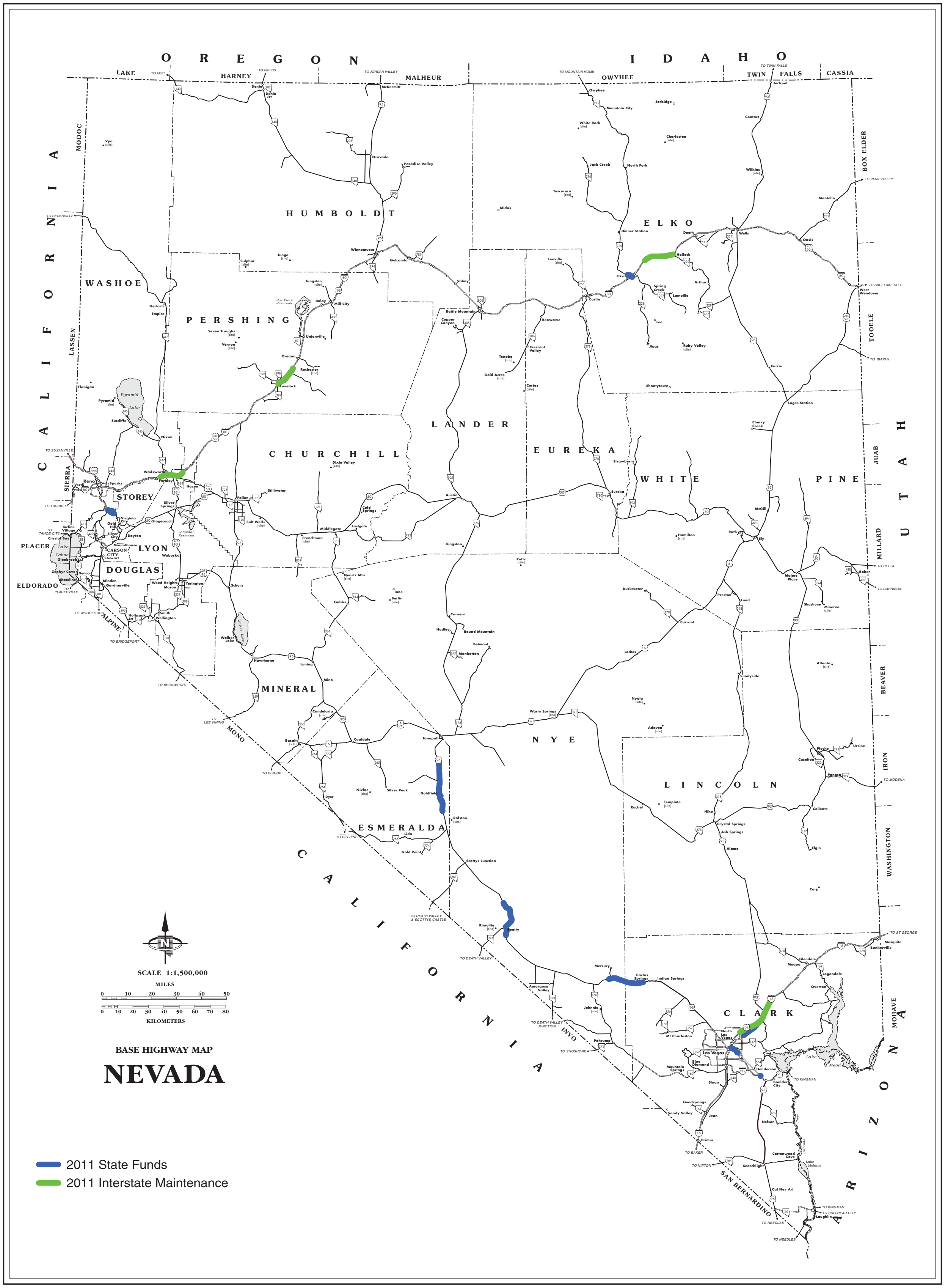


FIGURE 20: Overlay and Reconstruction Projects Planned for Fiscal Year 2011

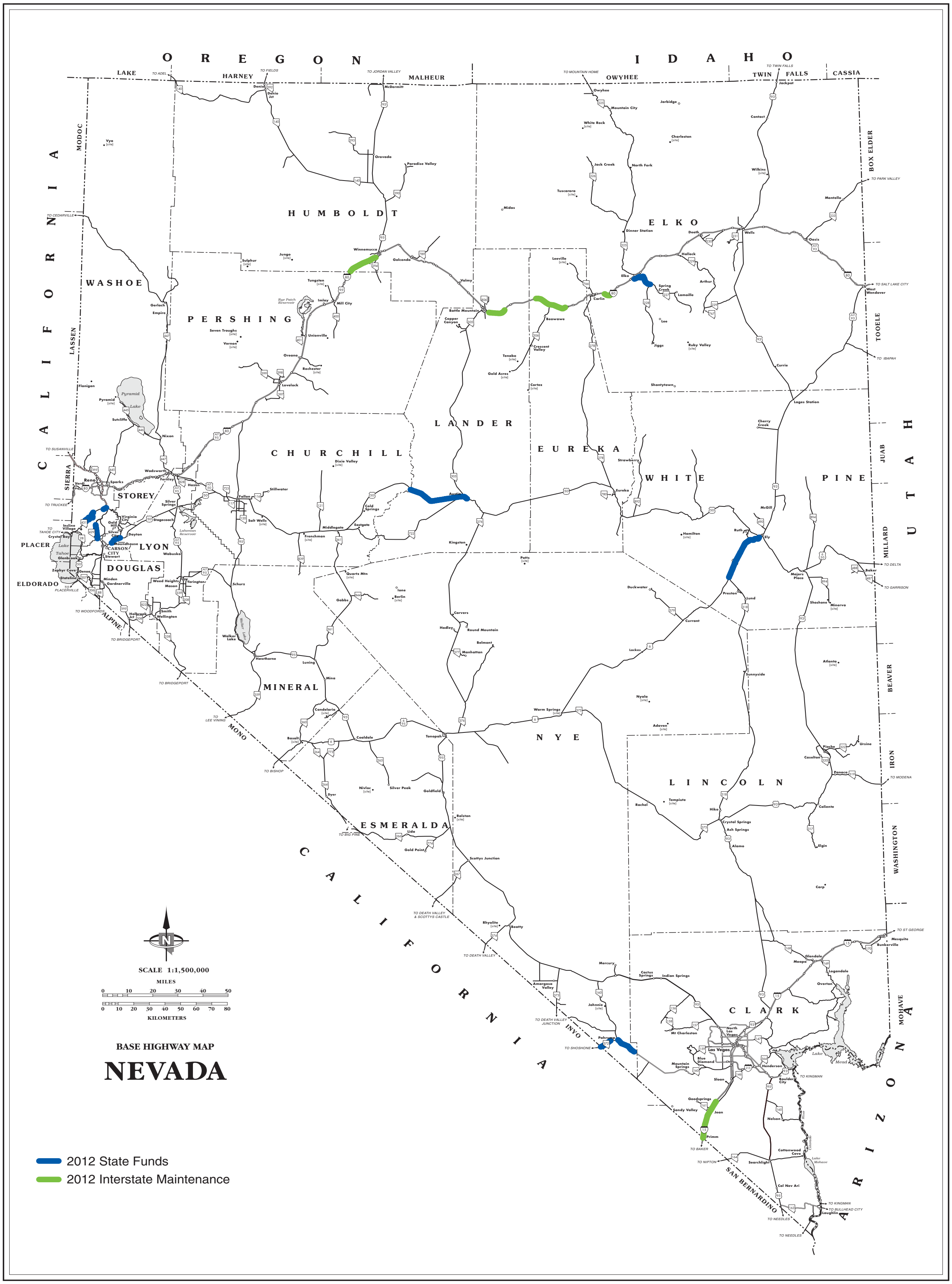


FIGURE 21: Overlay and Reconstruction Projects Planned for Fiscal Year 2012

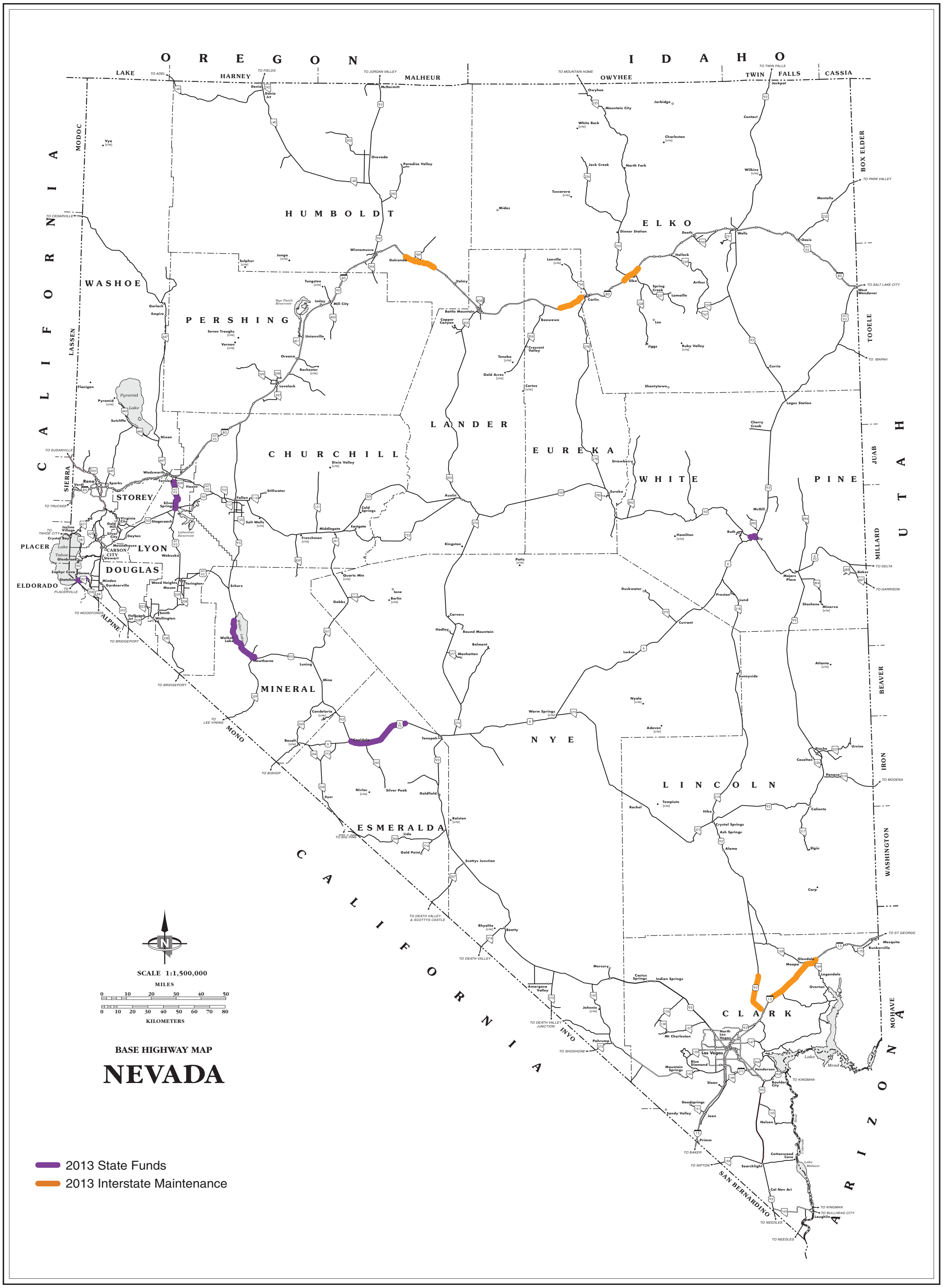


FIGURE 22: Overlay and Reconstruction Projects Planned for Fiscal Year 2013

The long-term action plan also includes an emphasis on the coordination and integration of routine pavement maintenance activities with planned overlay and reconstruction repair work. Routine pavement maintenance activities help to maintain the pavement functional condition, slow down the deterioration rate, and prevent premature structural failure. Neglecting routine maintenance will accelerate the effects of aging and deterioration as well as increase pavement life-cycle costs. Numerous benefits result when the performance of routine pavement maintenance activities are properly timed and integrated in the pavement management process.

PAVEMENT RESEARCH

(What research are we doing to improve our pavement?)

NDOT continuously strives to improve the pavement, quality of materials, and construction techniques used on the roadway network. Therefore, research is conducted both in-house and in partnership with different entities to deliver the best products and materials in the most cost-effective manner. Current NDOT research includes the following projects:

- Development of rut-resistant asphalt mixtures. A highly rut-resistant modified aggregate gradation for asphalt mixtures has been developed and is currently being used on West McCarran Boulevard in Reno. Samples will be tested at the University of Nevada, Reno to evaluate the rutting resistance of the field produced mixtures.
- Implementation of Superior Performing Asphalt Pavement (SUPERPAVE). There is continued effort to evaluate whether pavement mix designs can be further improved.
- Evaluation of the Mechanistic-Empirical Pavement Design Guide (MEPDG). MEPDG is a modern pavement design methodology based on engineering mechanics and empirical knowledge. This evaluation requires local calibration efforts in terms of materials used and in-service conditions (environment and traffic) which lead to pavement performance predictions. Significant progress has been made in the required material characterization over the last three to four years. Further efforts have been extended into quantifying the traffic analysis and environmental inputs. There have also been some preliminary design comparisons between the MEPDG and the current state-of-practice design method. The end result of these efforts will be a pavement design tool that can more accurately characterize the specific roadway conditions in Nevada and

allow engineers to more appropriately address those conditions for longer lasting roadways.

- Use of recycled asphalt pavement materials in highway construction. Uses include the addition of RAP into base layer aggregates, recycling the RAP as a dust control measure, and dirt road surface treatments. The first NDOT project to use RAP in the asphalt pavement was completed. The project was constructed on North McCarran Boulevard in Reno and samples were evaluated at the University of Nevada, Reno. NDOT has cautiously approached the use of RAP in the asphalt pavement layer due to concerns over possible detrimental effects RAP may have on the mixture and its resulting long-term performance.

- Development of crack resistant asphalt mixtures. This research will determine whether modifications can be made to asphalt mixtures that will increase the resistance to reflection cracking. Research has recently been completed to evaluate the effectiveness of current NDOT maintenance and rehabilitation procedures. Based on this research, guidelines have been developed to recommend the most appropriate maintenance and rehabilitation applications for differing pavement conditions throughout the state. Further research is currently underway to develop more crack resistant mixtures to be used in several of the recommended guideline applications.

- Use of recycled ground tire rubber. Rubberized asphalt in hot-applied chip seal surface treatments has been used on several projects. In addition, rubberized asphalt has been used for preservation overlays on several contracts and use of rubberized asphalt in more projects is planned. A crumb rubber overlay was used successfully on concrete pavement for noise reduction purposes in the Las Vegas area. Additionally, there is investigation into the potential for ground tire rubber to be blended into fill and base materials. Blended ground tire rubber materials have the potential to reuse hundreds of thousands of tires per year.

SUMMARY

The cost of delaying needed preservation repairs is very high as evidenced in the project-level case study of proactive pavement management. In practical terms, there is common agreement that every $1 invested proactively saves $6 or more reactively in future major rehabilitation and reconstruction costs. There is not approved pavement preservation funding that allows for the long-term proactive pavement management action plan. Without additional funding, more reconstruction repair methods will be required in the future. The effect of deferred funding will become more obvious to the motoring public as traveling on roads get rougher and distresses become more visible. The planned preservation expenditures for fiscal years 2011 through 2013 were not adequate to accommodate NDOT’s long-term action plan. There will be a need for additional funding to rehabilitate the roads that have deteriorated into the reconstruction repair category.

BRIDGE PRESERVATION

INTRODUCTION

This report summarizes the Nevada Department of Transportation's (NDOT) efforts to preserve the state's estimated $2 billion worth of bridge infrastructure. Preserving the bridge infrastructure is one of NDOT's highest priorities. Numerous resources are employed to maintain bridges in structurally sound, functional, and safe condition.

Although the focus in the following discussion is on state-maintained bridges, information on bridges maintained by other agencies is also included because these bridges are eligible for federal funds that are administered by NDOT. Moreover, NDOT is responsible for inspecting and reporting the condition of all public bridges in Nevada.

THE BRIDGE MANAGEMENT SYSTEM

(How do we care for our bridges?)

Bridges are managed via the PONTIS Bridge Management System. This system provides an inventory of bridge condition and location, needed repairs, load limits, susceptibility to flooding, and ownership information. A separate inventory allows NDOT to ascertain earthquake susceptibility and risks. These inventories, together with other factors, allow NDOT to identify preservation priorities and monitor the state's progress toward eliminating the backlog of bridge work.

Bridge Inventory

(What do we maintain?)

All public bridges in Nevada are included in the NDOT bridge inventory. There are currently 1,924 public bridges in Nevada. A bridge is a structure spanning 20 feet or more that carries traffic over a depression or obstruction, and includes multiple box culverts and pipes. The maintenance of the bridge inventory is shared by many different organizations: NDOT maintains 1,097 bridges; county and city governments maintain 691 bridges; federal agencies maintain 61 bridges; private entities maintain 45 bridges; and other local agencies maintain 30 bridges.

Bridge Condition Survey

(How do we assess our bridges' health?)

Bridge serviceability is evaluated by use of a numerical assessment called the sufficiency rating. Sufficiency ratings vary from 0 to 100. A 100 sufficiency rating represents a bridge with no deficiencies. While the sufficiency rating is primarily used to determine eligibility for federal funding, it is also used to assess the overall condition of a bridge.

The condition assessment consists of a physical inspection of the structure. The deleterious effects of age, environment, fatigue, hydrologic scour, settling, and traffic collisions are assessed in the evaluation. Every bridge in Nevada is inspected at least once every two years. Bridges in poor condition are inspected more often. Inspections affect the bridges' inventory ratings in addition to having impact on the condition rating.

The inventory rating denotes the strength of the bridge compared to design-truck loading. Structures with low condition or inventory ratings may be classified as "structurally deficient." The structurally deficient bridges are not necessarily about to fail. Rather, these bridges become a priority for corrective measures and may be posted to restrict vehicle weights.

The appraisal rating measures how well the bridge serves the public, or its functionality. Included in the appraisal rating are reviews of the deck geometry, under-bridge clearance, waterway adequacy, and approach geometry. Within the appraisal rating, a substandard structure is termed "functionally obsolete." Like structurally deficient bridges, functionally obsolete bridges are able to serve the traveling public. However, functionally obsolete bridges are susceptible to more congestion, collisions, or flooding because of the restrictive clearances and geometrics. Although functionally obsolete bridges are generally not as great a concern as structurally deficient bridges, these bridges can also become a priority for corrective measures and may be posted for vehicle size restrictions.

In addition to the sufficiency rating, a bridge's susceptibility to seismic activity is considered when assessing its condition or "health." Nevada is the third most seismically active state. Only the states of California and Alaska are more seismically active. The central and western parts of

Nevada are the most active, but southern Nevada does have the potential for damaging earthquakes. NDOT has replaced or retrofitted 104 bridge structures at a cost of over $32 million since it began including seismic activity as a component in the project prioritization process. Additionally, NDOT has placed a high priority on 128 more state-owned bridges in need of seismic retrofitting. The cost to upgrade bridges in need of seismic retrofitting is estimated at $64 million.

Generally, bridges with sufficiency ratings more than 80 are considered “good”, ratings of between 50 and 80 can be considered “fair”, and ratings less than 50 are considered “poor”. FIGURE 23 illustrates the condition of bridges in Nevada. Only 1 % of the bridges in Nevada are considered to be in poor condition. NDOT goes above and beyond the requirement in inspecting the bridges. The railroad crossings and the pedestrian structures are not required to be inspected by the Federal Highway Administration. For the sake of public safety, NDOT inspect these bridges, but does not provide any ratings.

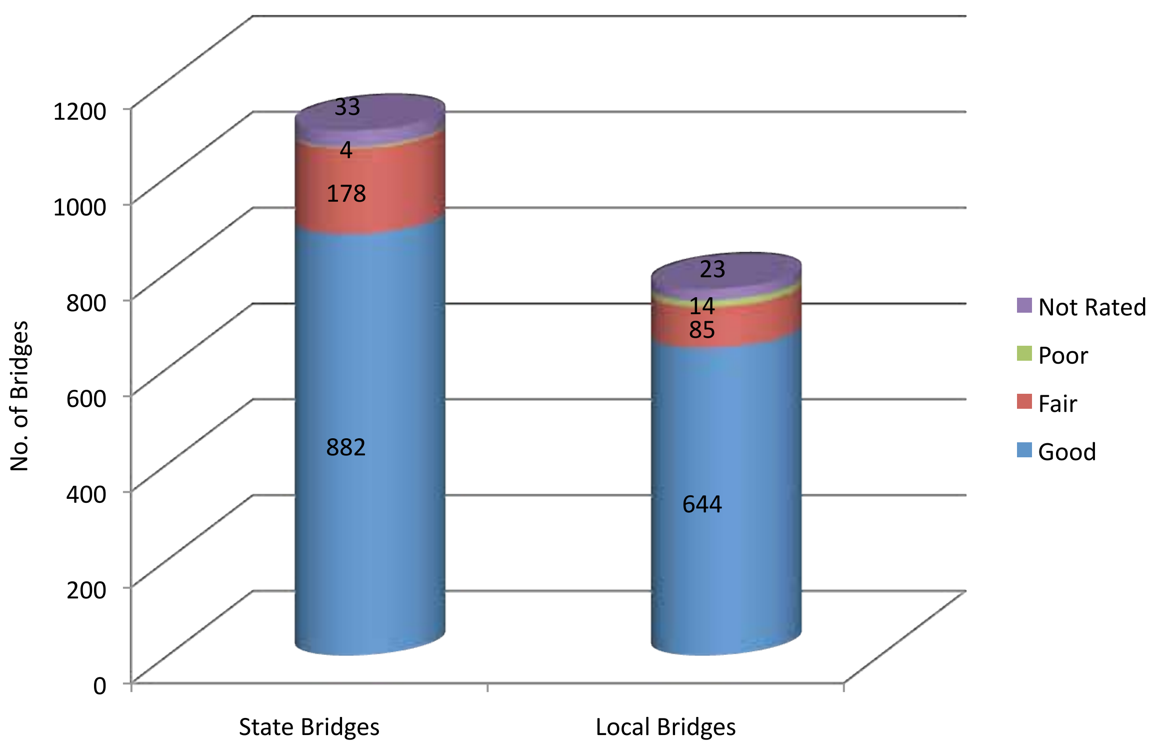


FIGURE 23: Condition of Bridges in Nevada

There are 1,097 bridges on the state-maintained system that were surveyed in 2010. Based on the survey, 140 or 12.8% of the bridges are functionally obsolete. Of the bridges surveyed, only 24 bridges are eligible for federal Highway Bridge Program (HBP) funding. The other 116 bridges are not eligible for federal funding. Another 18 or 1.6% of the bridges are structurally deficient and are eligible for federal funding.

There are 766 bridges on the locally-maintained system that were surveyed in 2010. Based on the survey, 25 or 3.3% of the bridges are functionally obsolete. Of the bridges surveyed, only 12 bridges are eligible for federal Highway Bridge Program (HBP) funding. The other 13 bridges are not eligible for federal funding. Another 17 or 2.2% of the bridges are structurally deficient and eligible for federal funding. FIGURE 24 summarizes the substandard bridge conditions on the state- and locally-maintained bridge network and eligibility for federal funding.

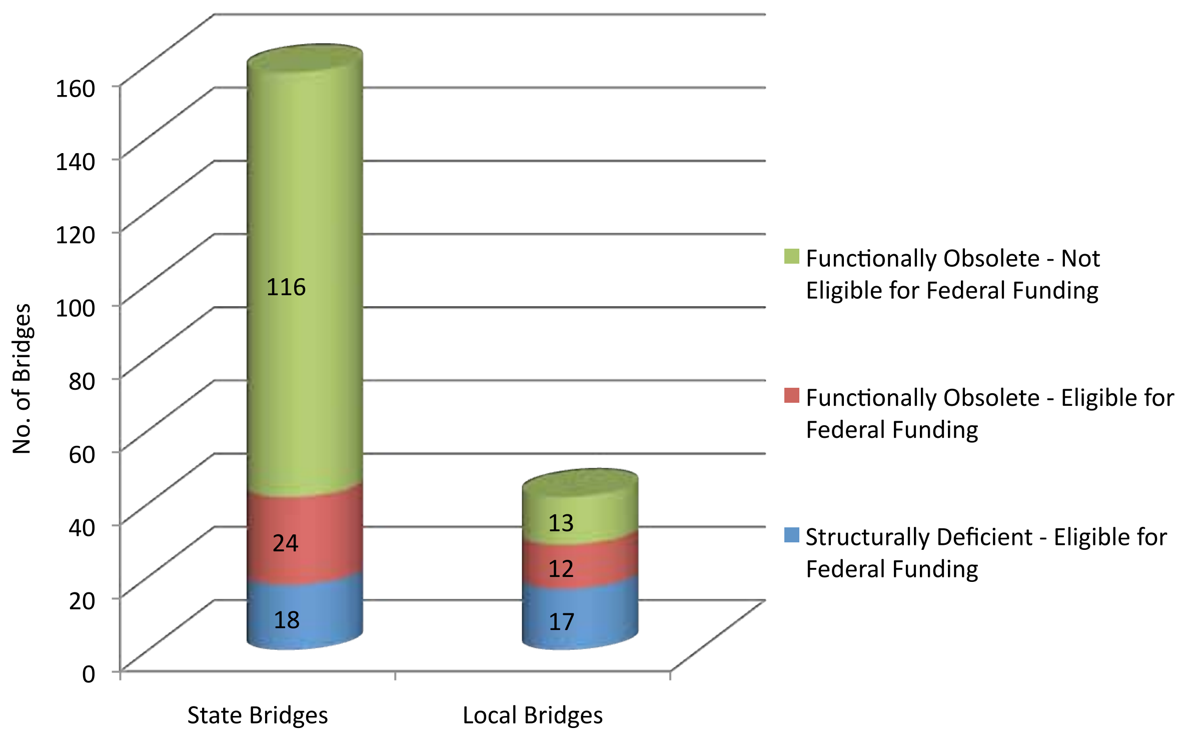


FIGURE 24: Substandard Bridges and Funding Eligibility

Nevada bridge conditions compare very favorably to the bridge conditions in many other states. Nevada's advantageous environment along with the relatively "young" age of the bridges contributes to the encouraging results. Most bridges have a service life of at least 50 years. Recently built bridges are expected to have a design life of 75 years. This prolonged design life was achieved by improvements in material, design, and construction methods. FIGURE 25 shows the age distribution of the State's bridges grouped by decade in which the bridge was originally constructed.

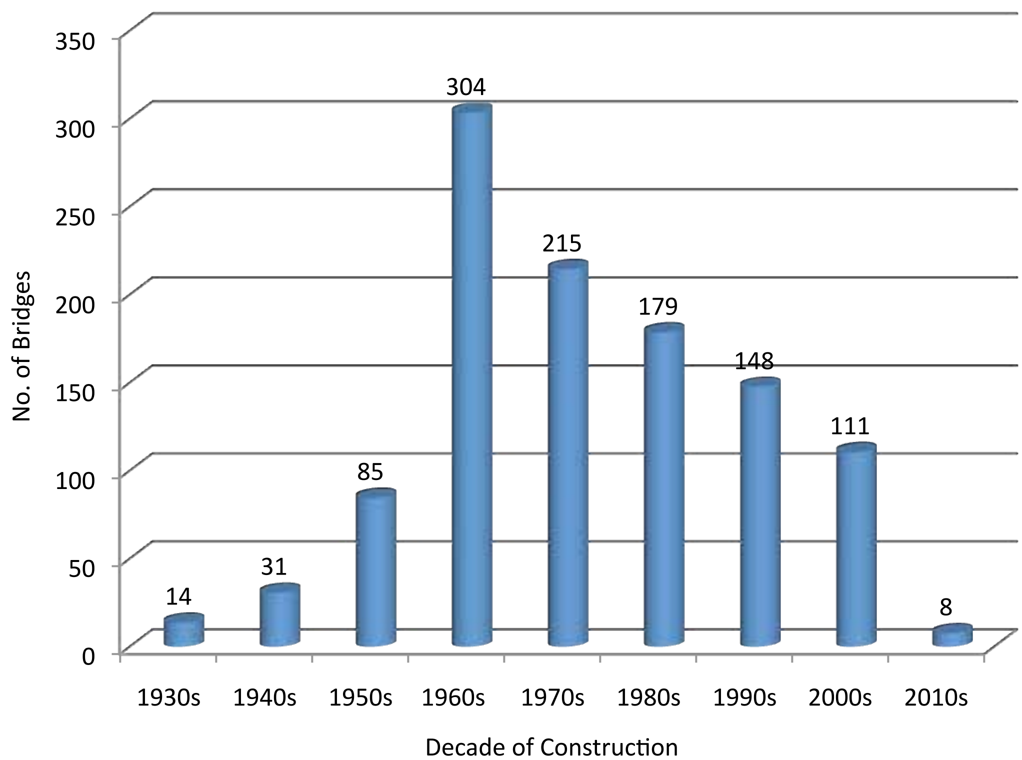


FIGURE 25: State Bridges, Decade of Construction

FIGURES 26A, 26B, 26C, 26D, and 26E locate the functionally obsolete and structurally deficient bridges in the State's bridge inventory.

Las Vegas Area

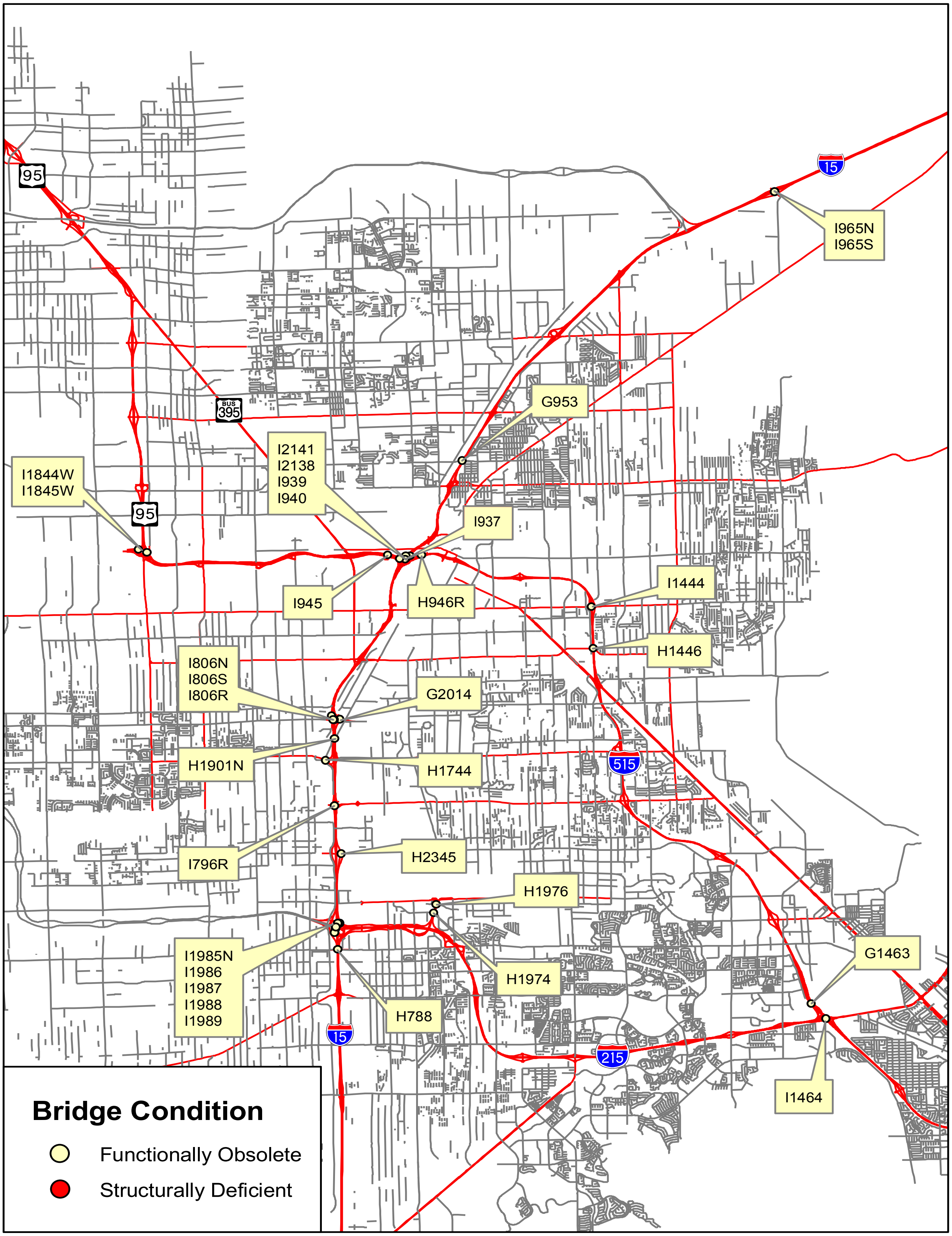


FIGURE 26A: Locations of Structurally Deficient and Functionally Obsolete Bridges

Southern Nevada

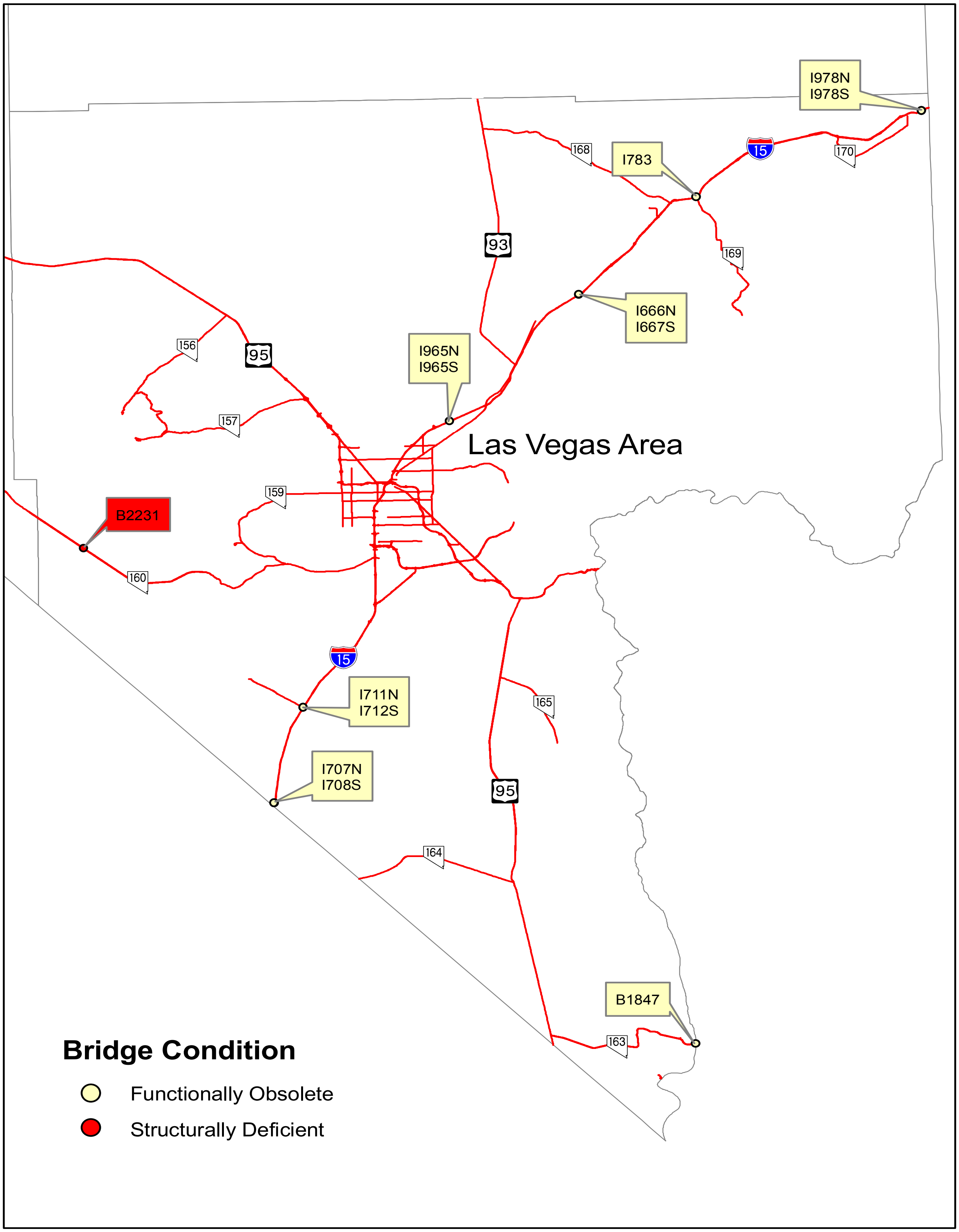


FIGURE 26B: Locations of Structurally Deficient and Functionally Obsolete Bridges

Reno Area

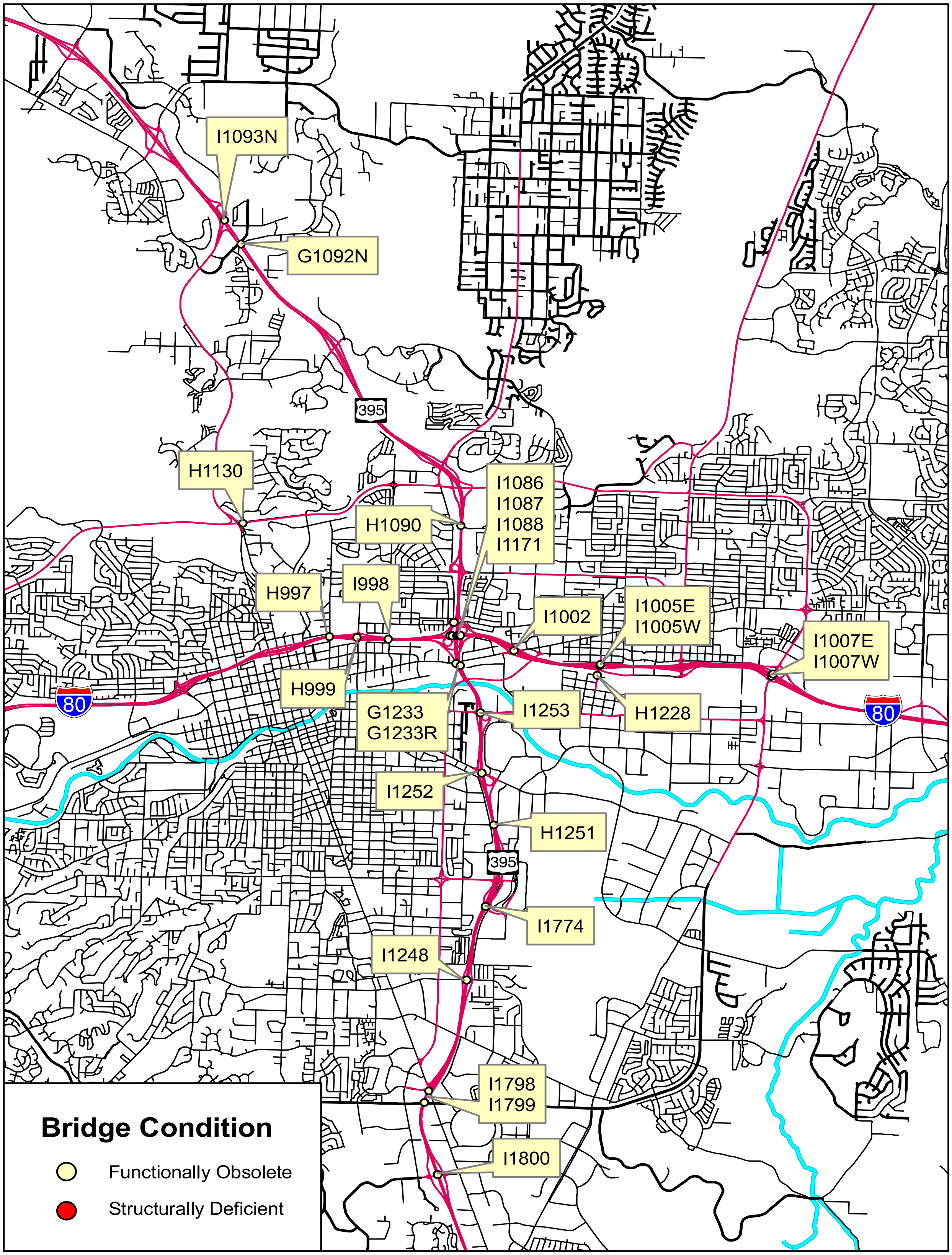


FIGURE 26C: Locations of Structurally Deficient and Functionally Obsolete Bridges

Northwest Nevada

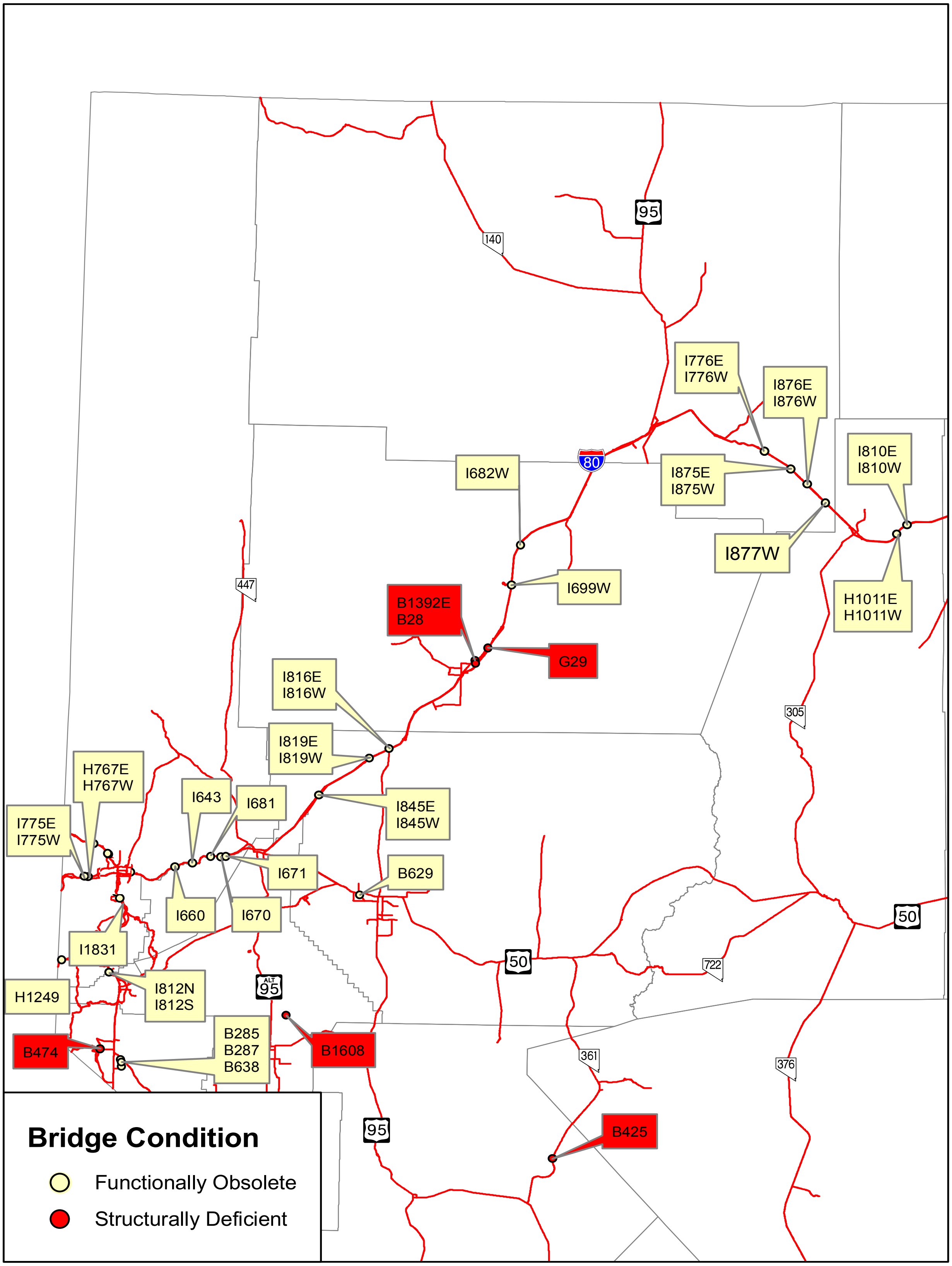


FIGURE 26D: Locations of Structurally Deficient and Functionally Obsolete Bridges

Northeast Nevada

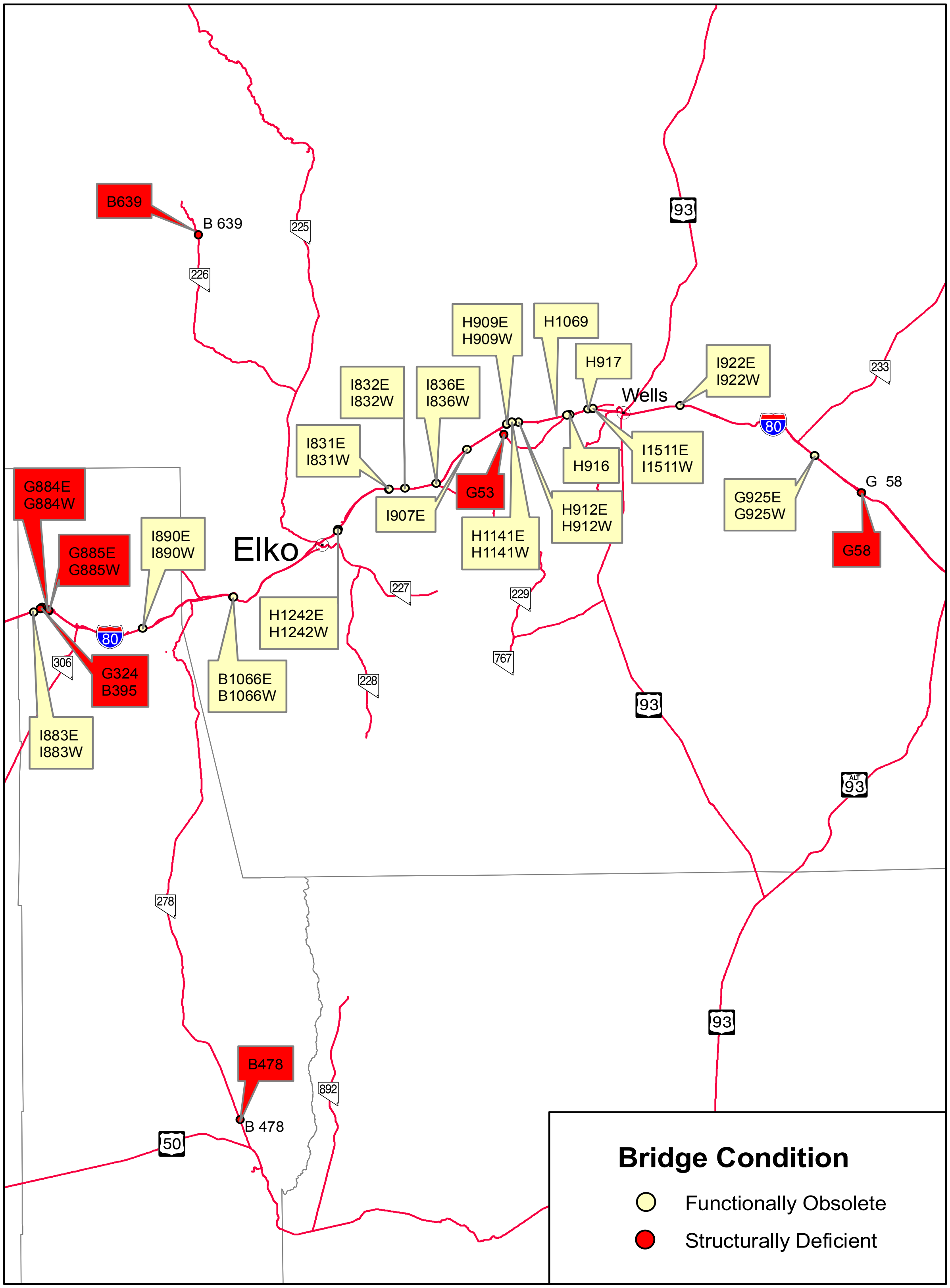


FIGURE 26E: Locations of Structurally Deficient and Functionally Obsolete Bridges

Bridge Condition over Time

(How has our bridge condition changed?)

FIGURE 27 illustrates bridge conditions grouped by good, fair, and poor categories. The number of bridges in each category has remained fairly stable since 1996. FIGURE 28 shows that the numbers of functionally obsolete and structurally deficient bridges eligible for federal funding have decreased significantly from 1996 through 2010.

FIGURE 29 demonstrates that the condition of locally-maintained bridges has retained a similar proportion of good, fair, and poor bridge conditions in comparison to the total number of bridges surveyed from 1996 through 2010. These conditions slightly improved over the years despite the fact that there were over two times as many bridges surveyed in 2010 as compared to 1996. FIGURE 30 depicts the number of functionally obsolete and structurally deficient locally-maintained bridges that are eligible for federal funding.

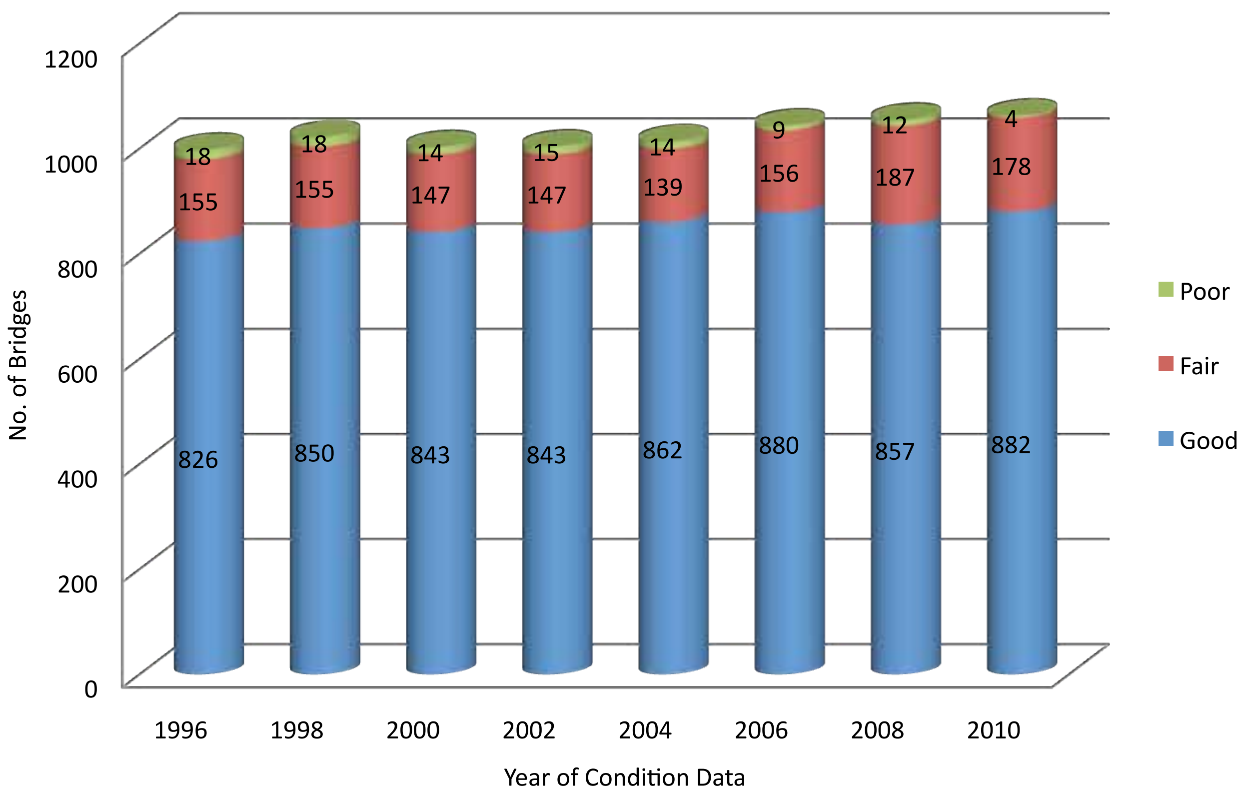


FIGURE 27: Conditions of State Bridges

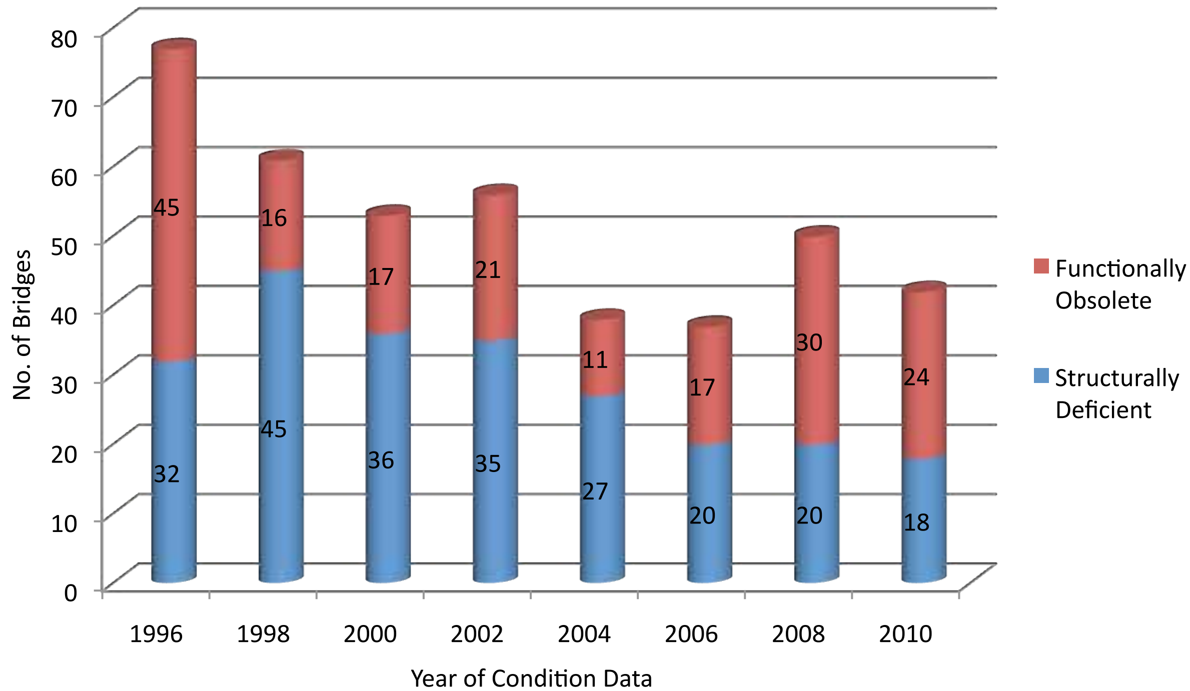


FIGURE 28: Substandard State Bridges Eligible for Federal Funding

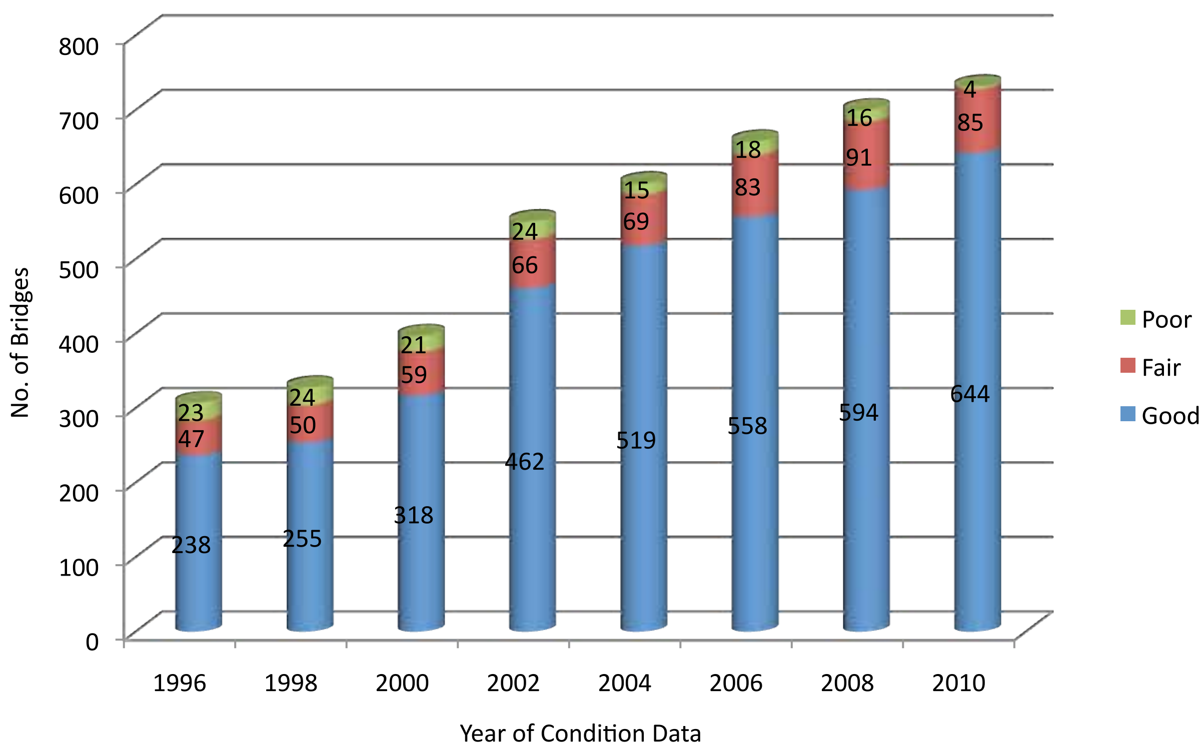


FIGURE 29: Conditions of Local Bridges

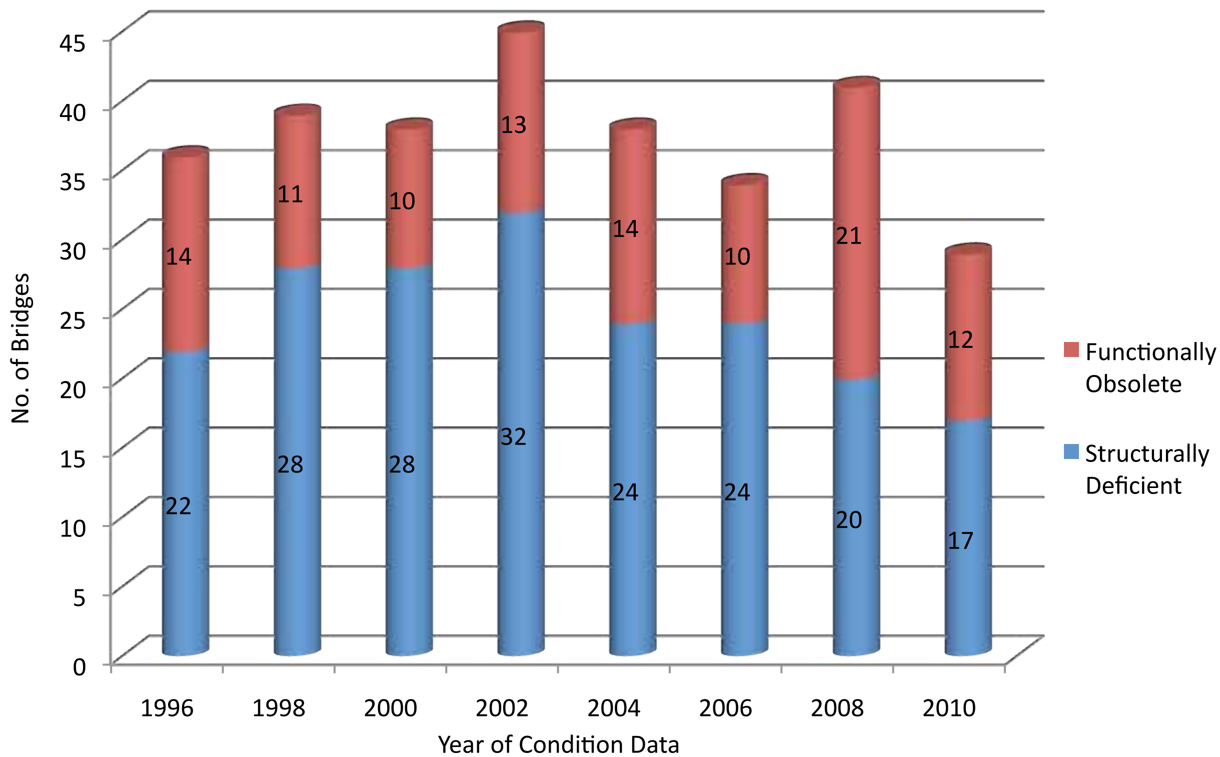


FIGURE 30: Substandard Local Bridges Eligible for Federal Funding

THE COST OF BRIDGE CLOSURE FOR OWNERS

(What will a bridge collapse costs?)

FIGURES 26A through 26E show the structurally deficient and functionally obsolete bridge locations. The deficient and obsolete bridges are primarily located on I-15 in Las Vegas and I-80 and US-395 in Reno. These routes connect Nevada with the rest of the country and carry hundreds of thousands of automobiles and trucks on a daily basis. If closure of a bridge in rural Nevada was required, the detour might add a few hundred additional miles to the travelers' journeys. A bridge closure and subsequent detours in urban areas will create extensive traffic jams and cause additional vehicle crashes. In both rural and urban bridge closures, the user costs due to travel delay or crashes will be quite significant until the bridge is reconstructed or repaired. Often, user costs due to delay or crashes can be in the hundreds of thousands of dollars per day. The importance of bridge maintenance and rehabilitation cannot be overemphasized.

The Nevada Interstates carry more than 100,000 vehicles daily in the Northern Nevada urban area and approximately 250,000 in the Southern Nevada urban area. The economic impacts of a bridge closure and subsequent activities are widespread. For example, the nationally reported bridge collapse in Minneapolis, Minnesota in 2007 had an economic impact on the state totaling $17 million in 2007 and $43 million in 2008 due to additional user costs. The additional user costs were estimated at $247,000 per day due to added travel time. The Minneapolis Bridge carried 140,000 vehicles daily before the collapse. This account does not include the compensations to the deceased and injured and the law suit expenses.

PROJECT PRIORITIZATION

(How do we select individual projects that assure efficient utilization of limited financial resources?)

The bridge preservation program competes for funding with capacity improvement, operations, pavement, hydraulic, and safety projects and programs. Since available funding is never unlimited, Engineers prioritize projects in such a manner that will improve the condition of the entire bridge infrastructure network while maximizing bridge performance and keeping costs to a minimum.

Bridge projects are developed and prioritized based upon bridge condition (sufficiency ratings and structurally deficient and functionally obsolete status), essentiality for public needs (NHS status, ADT, and ADTT etc...), and association of other ongoing project work at the same location (pavement rehabilitation work etc…). Seismic retrofit work is prioritized based on a bridge’s earthquake vulnerability and importance. The seismic vulnerability of all state-owned bridges has been investigated. Certain bridge types, such as large culverts, do not need seismic retrofit.

STATE BRIDGE PRESERVATION FUNDING

(How do we fund State bridge preservation?)

Similar to pavement rehabilitation, bridge work is paid for with fuel taxes and vehicle registration fees. Historically, available funding has only been sufficient to offset annual preventive/corrective maintenance costs.

Federal funds are available for bridge replacement, rehabilitation, or seismic retrofits. To qualify for replacement, the bridge must be either functionally obsolete or structurally deficient and have a sufficiency rating less than 50. To qualify for rehabilitation, the bridge must be either functionally obsolete or structurally deficient and have a sufficiency rating less than 80. Typically, about 85% of federal funds are spent on bridge replacement and rehabilitation and about 15% of federal funds are spent on seismic retrofit work.

Under federal funding guidelines, off-system bridges must receive a minimum of 15% of the available federal funds. Bridges are described as off-system when the bridges are not located on the federal aid highway system. Off-system roads include Rural Minor Collector and Rural and Urban Local roads. Bridges are described as on-system when the bridges are located on the federal aid highway system. The Interstate, Urban Collector, and Rural Minor Arterial roads are included in the federal aid highway system. Of the 1,097 state-maintained bridges, 1,019 bridges are on-system and 78 bridges are off-system. Of the 766 county, city, private, and other local bridges, 413 bridges are on-system and 353 bridges are off-system.

Biennial Expenditures for Fiscal Years 2009 to 2010

(What have we expended on bridges in the last two years?)

TABLE 8 lists approximately $20 million worth of bridge preservation work that NDOT obligated in fiscal years 2009 and 2010.

TABLE 8: Bridge Expenditures in Fiscal Years 2009 and 2010

Fiscal Year	Repair Strategy					Non preventive Total	Grand total
	Preventive Maintenance	Corrective Maintenance	Rehabilitation	Replacement	Seismic Retrofit		
2009	$531,679	$1,941,120	$0	$8,763,794	$0	$10,704,914	$11,236,593
2010	$731,025	$1,386,724	$326,156	$6,146,525	$0	$7,859,405	$8,590,430
Biennium Total	$1,262,704	$3,327,844	$326,156	$14,910,319	$0	$18,564,319	$19,827,024

TABLE 9 lists the numbers of bridges that NDOT rehabilitated, replaced, or seismically retrofitted during the last biennium for fiscal years 2009 and 2010.

TABLE 9: Numbers of Bridges Rehabilitated, Replaced, or Seismically Retrofitted in Fiscal Years 2009 and 2010

Fiscal Year	Entity	On Federal-Aid System?	Repair Strategy			
			Rehabilitation	**Replacement**	**Seismic Retrofit**	**Total**
2009	State	On-System		1		1
	Local/Other	On-System				
		Off-System				
2010	State	On-System	2	1		3
	Local/Other	Off-System				
		Total	**2**	**2**		**4**

Backlog of Bridge Preservation Work

(What will it cost to bring the bridges to excellent condition?)

Ideally, bridges maintained in fair or good condition for as long as possible will extend bridge service life and reduce the need for bridge replacement. Currently, a $131 million project backlog for bridge preservation work exists. Bridge preservation includes repair strategies such as corrective maintenance, rehabilitation, and replacement work. TABLE 10 lists the backlog of currently needed bridge repair work. Preventive maintenance needs are not included in the bridge project backlog because this work is performed using routine-maintenance funds.

TABLE 10: Backlog of Bridge Work, State Bridges 2011

(Based on 2010 Condition Data)

System	Repair Strategy Required				Total
	Corrective Maintenance	**Rehabilitation**	**Replace**	**Seismic Retrofit**	
Principal Arterial - Interstate	$18,880,000	$8,550,000		--	$27,430,000
Principal Arterial - Non-Interstate	$6,640,000	$8,550,000		--	$15,190,000
Minor Arterial	$3,160,000	$3,600,000		--	$6,760,000
Major Collector	$4,320,000	$3,600,000		--	$7,920,000
Minor Collector & Local	$2,280,000	$2,400,000	$4,940,000	--	$9,620,000
All				$64,000,000	$64,000,000
Total	**$35,280,000**	**$26,700,000**	**$4,940,000**	**$64,000,000**	**$130,920,000**

Present Funding Versus Needed Funding

(How much financial resource do we have? What will it take to bring the bridges to excellent Condition?)

The majority of the state-maintained bridges were built in the 1960s through the 1980s. Since bridges normally have a useful service life of 50 years, it can be estimated when the bridges will become due for major rehabilitation or replacement (Recently built bridges have a service life of 75 years). FIGURE 31 illustrates that many bridges become due for major rehabilitation or replacement beginning in 2010.

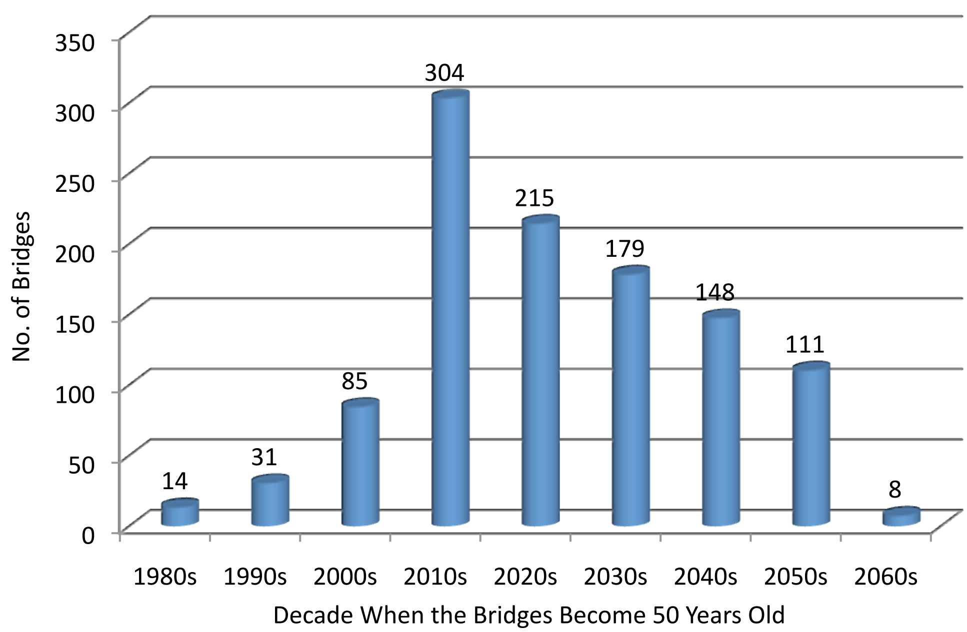


FIGURE 31: 50 Year Old Bridges

Under the present user-fee structure, the current $131 million project backlog of bridge work will increase gradually to $135 million in 2023. The needed funding scenario, which requires moderate revenue increases in future years, will eliminate the backlog in 2023 if funding is provided. FIGURE 32 highlights a comparison between the backlog if needs remain unfunded versus the backlog if funding becomes available. TABLE 11 lists the backlog and costs for both present funding levels and needed funding levels for bridge repair work. The table shows the incremental increase or decrease in funding needs depending upon whether funding is provided or not. If funding is not provided, the backlog will continually exist. If additional funding is provided, the backlog can be eliminated in 2023.

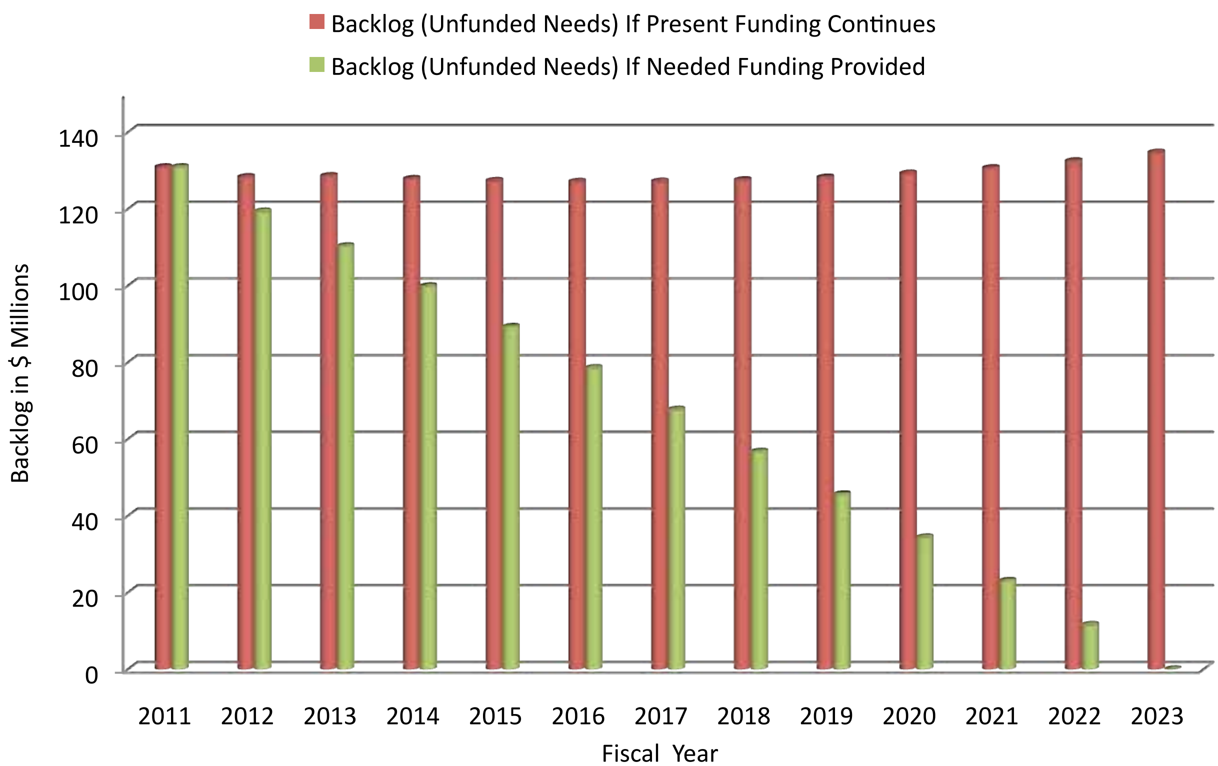


FIGURE 32: Backlog of Bridge Preservation Work With Present Funding vs. Needed Funding

BRIDGE PRESERVATION ACTION PLAN

(How will we improve our bridges? How do we prioritize available resources? What are the financial resources needed?)

NDOT's bridge preservation action plan is similar to plans detailed in previous State Highway Preservation Reports. The action plan is to preserve Nevada's public bridges in good condition by implementing the following bridge management practices:

- Replace or rehabilitate structurally deficient bridges before the bridges become hazardous or overly burdensome to users.
- Replace or rehabilitate functionally obsolete bridges before the bridges become hazardous or overly burdensome to users.
- Seismically retrofit bridges that do not meet current seismic standards.
- Apply timely repair strategies to existing structures.
- Apply consistent preventive maintenance strategies to existing structures.

TABLE 11 - Bridge Backlog, Costs, and Funding

State-Maintained System - 2011 - 2023 (in millions of dollars)

With Present Funding

Fiscal Year	Backlog of Bridge Work	Bridge Preservation Costs * (Normal Annual Deterioration Costs): Corrective Maintenance, Rehabilitation, and Replacement	Preventive Maintenance	Total	Bridge Preservation Funds ** (Funds Planned for Preservation Work): State Corrective Maintenance, Rehabilitation, and Replacement	Federal Corrective Maintenance, Rehabilitation, and Replacement	State Preventive Maintenance		Total
2011	**130.9**	12.2	0.6	12.8	8.2	6.6	0.6		15.4
2012	**128.3**	13.0	0.7	13.6	5.5	7.2	0.7		13.4
2013	**128.6**	13.8	0.7	14.4	5.5	9.0	0.7		15.2
2014	**127.9**	14.6	0.7	15.3	5.7	9.4	0.7		15.8
2015	**127.4**	15.5	0.7	16.2	5.9	9.7	0.7		16.4
2016	**127.1**	16.4	0.7	17.1	6.2	10.1	0.7		17.0
2017	**127.2**	17.3	0.8	18.1	6.4	10.5	0.8		17.7
2018	**127.5**	18.3	0.8	19.1	6.7	10.9	0.8		18.4
2019	**128.2**	19.4	0.8	20.2	7.0	11.4	0.8		19.1
2020	**129.3**	20.5	0.8	21.3	7.2	11.8	0.8		19.9
2021	**130.7**	21.7	0.8	22.5	7.5	12.3	0.8		20.7
2022	**132.5**	22.9	0.9	23.7	7.8	12.8	0.9		21.5
2023	**134.7**								

With Needed Additional Funding

Fiscal Year	Backlog of Bridge Work	Bridge Preservation Costs * (Normal Annual Deterioration Costs): Corrective Maintenance, Rehabilitation, and Replacement	Preventive Maintenance	Total	Bridge Preservation Funds ** (Funds Planned & Needed for Preservation Work): State Corrective Maintenance, Rehabilitation, and Replacement	Federal Corrective Maintenance, Rehabilitation, and Replacement	State Preventive Maintenance	Needed Additional Funds	Total
2011	**130.9**	12.2	0.6	12.8	8.2	6.6	0.6	**9.0**	24.4
2012	**119.4**	13.0	0.7	13.6	5.5	7.2	0.7	**9.3**	22.7
2013	**110.3**	13.8	0.7	14.4	5.5	9.0	0.7	**9.7**	24.9
2014	**99.9**	14.6	0.7	15.3	5.7	9.4	0.7	**10.1**	25.9
2015	**89.3**	15.5	0.7	16.2	5.9	9.7	0.7	**10.5**	26.9
2016	**78.6**	16.4	0.7	17.1	6.2	10.1	0.7	**10.9**	27.9
2017	**67.7**	17.3	0.8	18.1	6.4	10.5	0.8	**11.3**	29.1
2018	**56.7**	18.3	0.8	19.1	6.7	10.9	0.8	**11.8**	30.2
2019	**45.6**	19.4	0.8	20.2	7.0	11.4	0.8	**12.3**	31.4
2020	**34.4**	20.5	0.8	21.3	7.2	11.8	0.8	**12.8**	32.7
2021	**23.0**	21.7	0.8	22.5	7.5	12.3	0.8	**13.3**	34.0
2022	**11.6**	22.9	0.9	23.7	7.8	12.8	0.9	**13.8**	35.3
2023	**0.0**								

* Inflation assumed at 3% per annum.
** Revenue growth rate assumed is 4% per annum.

Note: Backlog of Bridge work is as of beginning of fiscal year; preservation costs are those incurred during the fiscal year; and preservation funds are those that are available during the fiscal year.

BRIDGE RESEARCH

(What research are we doing towards safe and long lasting bridges?)

Since bridges represent a major capital investment, NDOT must do what it can to make the bridges perform as well and as long as possible. Field trial installations have been initiated and continued for new products/materials that demonstrate significant potential for improving bridge performance and providing bridge protection. Applications currently under study include bridge deck protective overlay and membrane systems, bridge expansion joint systems and bridge deck crack sealants.

SUMMARY

The State has enjoyed the benefit of favorable bridge conditions as compared to the bridge conditions in many other states for quite a while. Nevada's favorable environment, along with the relatively "young" age of the bridges, has contributed to the encouraging results. However, bridge assets are aging. 304 bridges will become at least 50 years old in the years from 2010 through 2019. Another 215 bridges will become 50 years old in the years from 2020 through 2029. After the useful service life of 50 years, costs for major rehabilitation or replacement rise as bridges require more than corrective maintenance strategies. The aging bridges will add an additional strain on present funding allocations. Backlog will continue to exist unless moderate revenue increases are committed to bridge preservation efforts.

STATE HIGHWAY PRESERVATION REPORT

Brian Sandoval,
Governor

Susan Martinovich, P.E.,
Director

Nevada Department of Transportation
1263 South Stewart Street
Carson City, Nevada 89712
(775) 888-7000
Fax (775) 888-7115
www.nevadadot.com